

# BYTE<sup>®</sup>

the small systems journal

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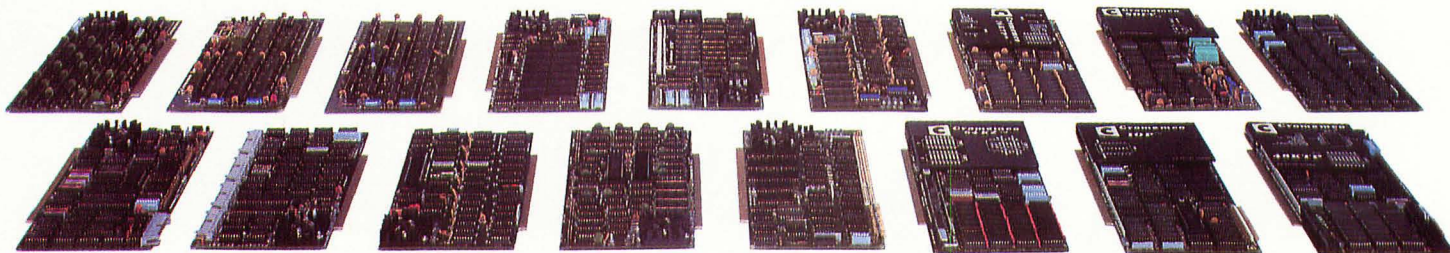




# A new small computer that won't limit you tomorrow



New Cromemco System One shown with our  
high-capability terminal and printer.



Expandability



Here's a low-priced computer that won't run out of memory capacity or expandability halfway through your project.

Typically, computer usage tends to grow, requiring more capability, more memory, more storage. Without a lot of capability and expandability, your computer can be obsolete from the start.

The new System One is a real building-block machine. It has capability and expandability by the carload.

Look at these features:

- **Z80-A processor**
- **64K of RAM**
- **780K of disk storage**
- **CRT and printer interfaces**
- **Eight S-100 card slots, allowing expansion with**
  - **color graphics**
  - **additional memory**
  - **additional interfaces for telecommunications, data acquisition, etc.**
- **Small size**

### **GENEROUS DISK STORAGE**

The 780K of disk storage in the System One Model CS-1 is much greater than what is typically available in small computers. But here, too, you have a choice since a second version, Model CS-1H, has a 5" Winchester drive that gives you **5 megabytes** of disk storage.

### **MULTI-USER, MULTI-TASKING CAPABILITY**

Believe it or not, this new computer even offers multi-user capability when used with our advanced CROMIX\* operating system option. Not only does this outstanding O/S support multiple users on this computer but does so with powerful features like multi-

ple directories, file protection and record level lock. CROMIX lets you run multiple jobs as well.

In addition to our highly-acclaimed CROMIX, there is our CDOS\*. This is an enhanced CP/M† type system designed for single-user applications. CP/M and a wealth of CP/M-compatible software are also available for the new System One through third-party vendors.

### **COLOR GRAPHICS/WORD PROCESSING**

This small computer even gives you the option of outstanding high-resolution color graphics with our Model SDI interface and two-port RAM cards.

Then there's our tremendously wide range of Cromemco software including packages for word processing, business, and much more, all usable with the new System One.

### **ANTI-OBSOLESCENCE/LOW-PRICED**

As you can see, the new One offers you a lot of performance. It's obviously designed with anti-obsolence in mind.

What's more, it's priced at only \$3,995. That's considerably less than many machines with much less capability. And it's not that much more than many machines that have little or nothing in the way of expandability.

Physically, the One is small — 7" high. And it's all-metal in construction. It's only 14 7/8" wide, ideal for desk top use. A rack mount-option is also available.

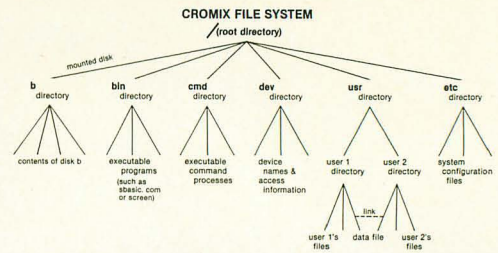
### **CONTACT YOUR REP NOW**

Get all the details on this important building-block computer. Get in touch with your Cromemco rep now. He'll show you how the new System One can grow with your task.

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## CROMIX\* — Cromemco's outstanding UNIX<sup>†</sup>—like operating system

CROMIX is just the kind of major development you've come to expect from Cromemco. After all, we're already well-known for the most respected software in the microcomputer field.

And now we've come up with the industry's first UNIX-lookalike for microcomputers. It's a tried and proven operating system. It's available on both 5" and 8" diskettes for Cromemco systems with 128K or more of memory.

Here are just some of the features you get in this powerful Cromemco system:

- Multi-user and multi-tasking capability
- Hierarchical directories
- Completely compatible file, device, and interprocess I/O
- Extensive subsystem support

### FILE SYSTEM

One of the important features of our CROMIX is its file system comprised of hierarchical directories. It's a tree structure of three types of files: data files,

directories, and device files. File, device, and interprocess I/O are compatible among these file types (input and output may be redirected interchangeably from and to any source or destination).

The tree structure allows different directories to be maintained for different users or functions with no chance of conflict.

### PROTECTED FILES

Because of the hierarchical structure of the file system, CROMIX maintains separate ownership of every file and directory. All files can thus be protected from access by other users of the system. In fact, each file is protected by **four separate access privileges** in each of the three user categories.

### TREMENDOUS ADDRESS SPACE, FAST ACCESS

The flexible file system and generalized disk structure of CROMIX give a disk address space in excess of one gigabyte per volume — file size is limited only by available disk capacity.

Speed of access to disk files has also been optimized. Average access speeds far surpass any yet implemented on microcomputers.

### 'C' COMPILER AVAILABLE, TOO

Cromemco offers a wide range of languages that operate under CROMIX. These include a high-level command process language and extensive subsystem support such as COBOL, FORTRAN IV, RATFOR, LISP, and 32K and 16K BASICs.

There is even our highly-acclaimed 'C' compiler which allows a programmer fingertip access to CROMIX system calls.

### THE STANDARD O-S FOR THE FUTURE

The power and breadth of its features make CROMIX the standard for the next generation of microcomputer operating systems.

And yet it is available for a surprisingly low \$595.

The thing to do is to get all this capability working for you now. Get in touch with your Cromemco rep today.

\*CROMIX is a trademark of Cromemco, Inc.

†UNIX is a trademark of Bell Telephone Laboratories



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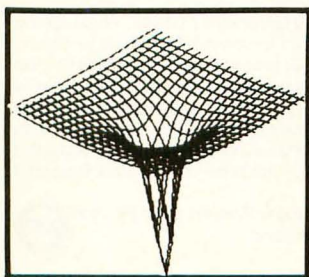
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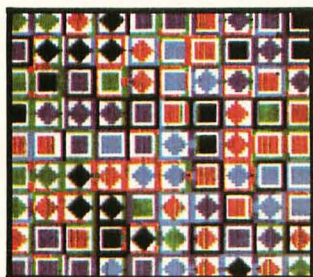
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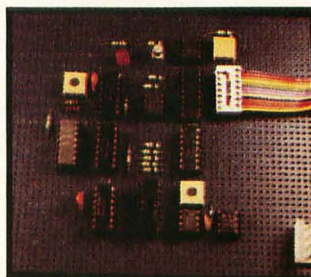
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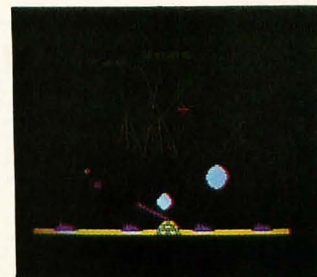
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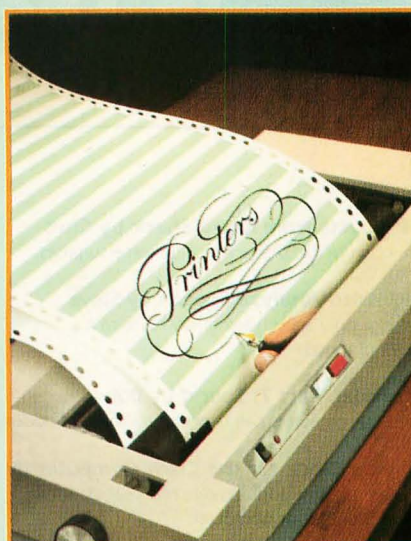
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## In This Issue

Hard copy was once considered a luxury by computer hobbyists, but now the ability to record program listings and text on paper is seen as almost a necessity. And though you're not likely to find a printer like the one Robert Tinney pictured on this month's cover, you're sure to find one from the many available that will fit your needs. For a rundown on what's around, see Curtis Feigel's printer directory. For a look at a new approach to printers, see Ed Umlor's review of the Prism Printer. We've also included a report on custom and standardized forms: where to get them and how to use them. And we have an article on programming your computer to fill in forms.

The Atari Tutorial continues with Part 7: Sound; William Barden Jr. discusses building a half-year clock for the Color Computer in the fourth article in his series on Radio Shack computers; in Part 2 of the "Input/Output Primer" Steve Leibson discusses interrupts and direct memory access; and Steve Ciarcia writes about using voiceprints to analyze speech. Don't miss our quarterly games feature, "BYTE's Arcade," plus our regular items and reviews.

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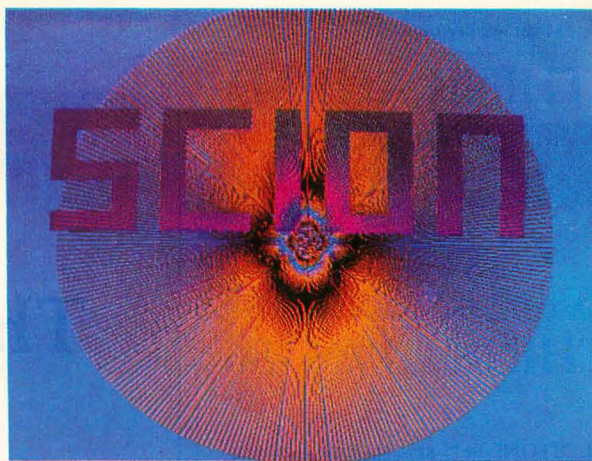
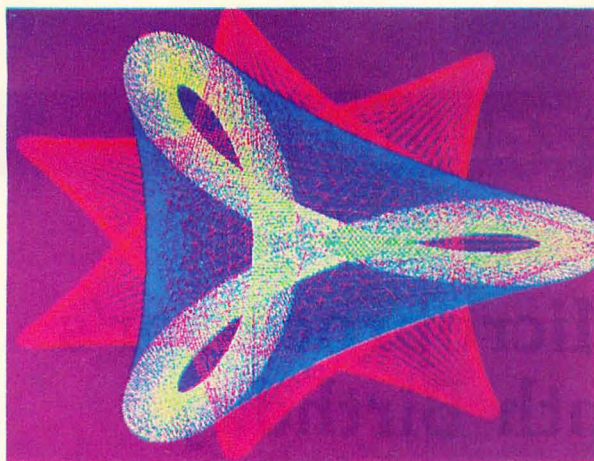
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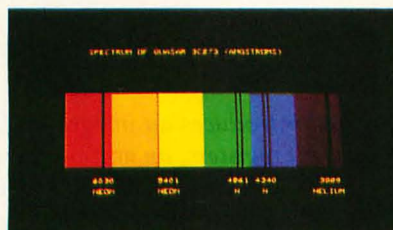
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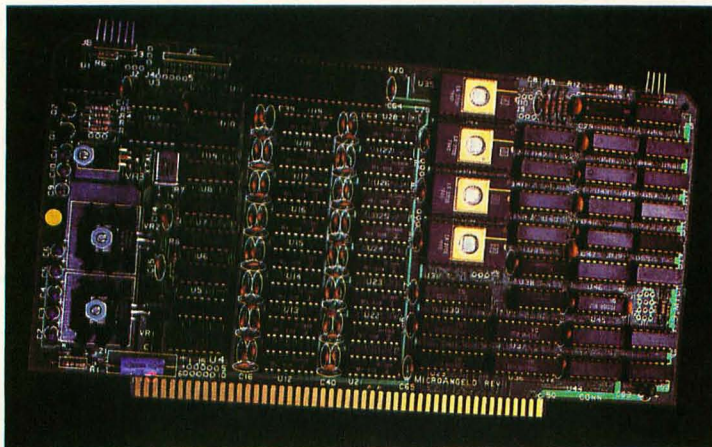
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## Editorial

# The Microprocessor's Tenth Birthday

by Chris Morgan, Editor in Chief

*"... Intel introduces an integrated CPU complete with a 4-bit parallel adder, sixteen 4-bit registers, an accumulator, and a push-down stack on one chip. It's one of a family of four new ICs which comprise the MCS-4 microcomputer system—the first system to bring you the power and flexibility of a dedicated general-purpose computer at low cost in as few as two dual in-line packages..."*

—from the first microprocessor advertisement in the November 15, 1971 issue of *Electronic News*

It's hard to believe, but the microprocessor celebrated its tenth birthday this past November. The event slipped by with little comment from the technical press. We nearly missed it ourselves in the rush to keep up to date in an industry that refuses to slow down and wait for anyone. Nevertheless, it's staggering to realize that ten years have gone by since the calculating powers of the computer were first squeezed onto a small square of silicon. The first microcomputer was actually a family of four integrated circuits known collectively as the "MCS-4 system." It consisted of the 4004 CPU (central processing unit) that featured a set of 45 instructions, the 4001 ROM, the 4002 RAM, and the 4003 shift register.

Ironically, it was a Japanese calculator company called Busicom (now out of business) that spurred the creation of the microprocessor. As Ted Hoff Jr., inventor of the 4004, put it, "The development came as all good ideas do. I looked at a customer's proposed design and said, 'There ought to be a better way.'"

The "better way" came about in 1971 when Busicom contracted the newly formed Intel company to develop a family of integrated circuits that Busicom could use in a proposed line of programmable calculators. The Japanese company had already designed the calculator with about a dozen proposed MOS chips, and it wanted Intel to complete the design. Intel had only two designers at the time, though, and probably would have been hard pressed to design the chips quickly enough if it had not been for Hoff's inspiration. It was all related to Hoff's admiration for the architecture of DEC's PDP-8, a mini-



Ted Hoff Jr., inventor of the 4004.



# PERCOM

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Other computer? \_\_\_\_\_

(☐ floppy disk or ☐ hard disk?)

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## Editorial

computer he had been using for some time. "The PDP-8 was a nice machine: simple, yet it could do a lot. I looked at the PDP-8, I looked at the proposed Busicom, and I wondered why the calculator should be so much more complex." Busicom was initially uninterested in the proposed microprocessor. Nevertheless, Hoff's supervisors encouraged him to continue with the design, and Busicom finally relented.

As it turned out, the final configuration of the 4004 in the Busicom calculator was "pretty exotic," as 4004 design team member Stan Mazor describes it. "Shima Masutashi [another member of the 4004 design team who was later to design the 8080] and I worked on the design of the calculator. He wrote a 19-byte interpreter in MCS-4 machine code for the calculator. It performed the relatively trivial task of fetching the next pseudo-byte and jumping to a subroutine. I laughed when I realized that what we had inside the desk calculator was a computer programmed as an interpreter emulating a pseudo-language."

Intel didn't realize at first what it had. An article in a recent issue of Intel's house magazine, *Solutions*, points out that "Intel's own board of directors could not agree on whether to proceed with the sale of the 4004. Their resistance was underscored by the company's marketing department which, based on the belief that microprocessors would only be sold as minicomputer replacements, initially estimated the entire worldwide market at only a few thousand units per year." Today, as we all know, Intel's initial sales estimate was off by several orders of magnitude.

Situations like this are not uncommon in the technical world. A similar situation occurred at the Philadelphia Centennial Exposition of 1876. In a small pavilion at the fair, Alexander Graham Bell exhibited his newly invented telephone to a moderate number of politely interested people. Down the midway, though, thousands lined up to view the real technological hit of the show: the Corliss Steam Engine. I'll refrain from saying which of these two gadgets ultimately became a household item. But I will say that I don't have a princess model Corliss Steam Engine in my den.

Of course the microprocessor ultimately "made it" too, and it continues to affect our lives every day. The personal computer simply would not exist today without the microprocessor. In fact, it created a revolution. In his book *Promise of Power*, Carl Stokes said, "When you start dealing with change you are talking about interfering with those who are in possession of something." This concept doesn't apply to the microprocessor revolution, though, because microprocessors do not deny anything to anyone. Instead, they offer everyone a new tabula rasa. Not even the mainframe computer companies really suffered when the microprocessor appeared: they simply regrouped and continued marching (although it took some of them a long time to do it, and some of them haven't started yet).



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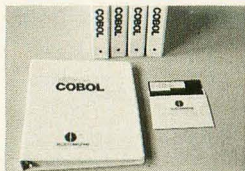
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## Editorial



Smith-Corona's new letter-quality printer, the TP-1.

We congratulate Intel on the tenth anniversary of the fortuitous invention that made personal computing possible, and we look forward to the day in 1992 when we can examine the second decade of the microprocessor.

\* \* \* \* \*

### An \$895 Daisy-Wheel Printer

This month's theme is printers, and the most exciting news in the fast-changing printer market is undoubtedly Smith-Corona's new \$895 (suggested retail) letter-quality printer, the TP-1. It features a plastic daisy wheel plus either an RS-232C serial interface or a Centronics-style parallel interface. Maximum speed of the TP-1 is between 14 and 15 characters per second, but the average speed is closer to 12 characters per second.

Smith-Corona makes no apologies for the fact that the TP-1 is a bare-bones system, and even though it lacks such niceties as proportional spacing, double-striking capability, and bidirectional printing, it's still a bargain. Price-wise, its closest competitor is in the \$1500 range. The American-made unit accepts letter or legal-sized paper, and, in a new version, will soon be able to handle fanfold paper. The TP-1 has some competition in the form of add-on boards that convert the Olivetti Praxis typewriter into a letter-quality printer. They're manufactured by Vertical Data Systems Inc., Mississauga, Ontario, Canada (Converter TP35); Williams Laboratories, Ithaca, New York (Bytewriter); and Systemed Corporation, Mountain City, Tennessee (Typrinter). We plan to review these units as soon as possible, for they herald the beginning of a new age of affordable word-processing computer systems. ■

### Acknowledgments

Thanks to Donna Shuster and Intel for permission to reprint quotes and comments from the article "Tenth Anniversary of the Microprocessor" in the November/December 1981 issue of Solutions.



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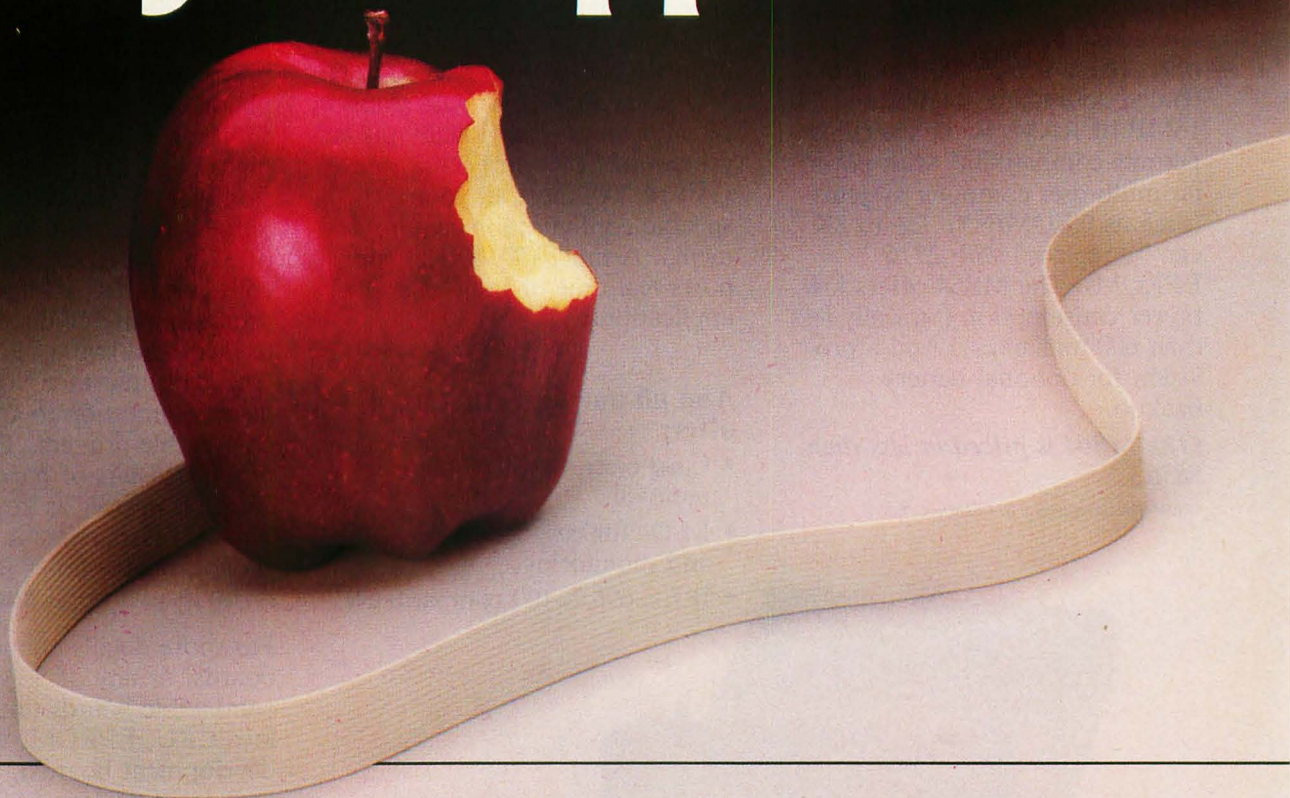
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# Letters

## Apple's Decision Questioned

We use Apple computers for commercial machine-language program development and buy Apple IIs at frequent intervals, either as a service to our customers or in order to expand our office.

I have recently spoken to a mail-order distributor of Apples who told me that as of December 4, 1981, Apple was no longer wholesaling to mail-order houses. I could not believe this, so I called CALL-A.P.P.L.E. It's true, I was told.

I am outraged. How can Apple, with new, large, clever, powerful competitors just beginning to breathe down its neck, remove the only way for small, intelligent users to buy Apples inexpensively?

Apple is, in effect, forcing us to buy from retail stores, which are usually overpriced. Their personnel are insulting in their inexperience and knowledgeable only about the latest space games. We can not afford their arbitrary \$700 markup on the Apple II. Our software systems, while cost-effective with mail-order firms' prices, are not with the retail stores' prices.

Apple will have to decide just who its friends are—the retailer who sits on his duff selling other people's ideas or the software innovator who takes a piece of hardware and makes it usable by the masses. While Apple may be trying to help out its dealers, it seems to have decided to do this at the expense of its serious customers—the people on whose success its own ultimate success depends.

Apple has succeeded so far because it provides a product which we (and others) can program without too much trouble and which our customers can afford. This new attitude of demanding that we submit to retailers' ridiculous prices will compel many to reconsider which personal computer we will use to develop our systems. I hope Apple discovers its error before its competitors profit too much from it.

**Dennis Gerald Pratt**  
666 North Dearborn, Apt 3F  
Chicago, IL 60610

*Yes, it is true. Apple Computer Inc. has given its dealers an ultimatum: either cease all mail and phone order sales, or your authorized dealership will be terminated effective December 4, 1981. This*

*was delivered in a "Notice of Dealer Agreement Modification" dated November 2, 1981, and dealers had until November 20, 1981, to sign and return the "modification." Otherwise, Apple threatened to pull the plug, so to speak.*

*Apple is attempting to justify this move by stating: "We believe that our ability to maintain a leadership position in competition with the corporate giants now entering the personal computer field depends in large measure on the willingness of our dealers to satisfy the end user with their familiarity with Apple products and their commitment to passing on this knowledge and support." Accordingly, Apple has added subparagraph 3 (g)(iv) to its Authorized Dealer Sales Agreement: "Dealer and Apple recognize that because of the special, technical nature of Apple Products, customers purchasing them can be properly served only if they have the benefit of pre- and post-sale education, orientation and support, specifically including in-person contact with the selling dealer, in order that each customer's needs may be properly served and the features, benefits, operation and applications of the Apple Products being purchased may be demonstrated and fully explained by knowledgeable sales personnel." It then goes on to specifically prohibit mail and telephone order sales of Apple products under penalty of losing the dealership.*

*Apple concluded its modification notice with the following paragraph:*

*"Apple personal computer products demand innovative and creative marketing. We are willing to work with all who are willing to meet that challenge. Those who are unwilling to expend the effort have no place in our future plans." . . . MH*

## Is Microfiche the Answer?

This letter is in response to the letter of Lew Merrick (October 1981 BYTE, page 10) regarding the storage bulk of advertising material in BYTE back issues.

The separation of advertising material into a separate removable section is undesirable because it would reduce the exposure of the advertising, reduce the value of the advertising, and ultimately degrade the quality of BYTE by reducing revenues.

An alternative is to convert to microfiche files at some loss of convenience but

great savings in space. BYTE is now available from University Microfilms, Ann Arbor, Michigan, but you must be very patient with them because (1) back issues are available only in one-year blocks, (2) back issues are not produced until well into the following year, and (3) orders are not filled promptly.

My suggestion is that BYTE offer a microfiche subscription option, just as is now done with the IEEE journals. The microfiche might actually be cheaper to produce and ship than the paper edition.

A microfiche viewer can be used for many purposes and occupies about as much space as three years of BYTE. The space needed to store the fiche is negligible.

Back issues of BYTE are well worth preserving, as they enable me, after a session on my modest micro, to ponder what little was available only five years ago and to speculate what the future holds. The advertisements in a five-year-old BYTE issue contain some very interesting material.

**Richard Schwartz**  
Electrical Engineer  
Star Fleet Engineering  
1328 North Santa Anita Ave  
Arcadia, CA 91006

## More on the WAI

Regarding Dr. S. S. Reddi's "Where Am I?" instruction (Technical Forum, November 1981 BYTE, page 413), I would like to point out that Motorola's 6809 has such an instruction. The simplest form is:

TFR PC,X

The instruction transfers the value in PC (program counter) to register X. (The value transferred is the location of the next instruction.) The 6809 also allows:

LEAX n,PC

which adds "n" (8 or 16 bits) to PC and puts the result in register X. (LEA = Load Effective Address) This instruction, which may also be written:

LEAX label,PCR

can compute the address of any label (location) within the program without using an absolute address (PCR means use



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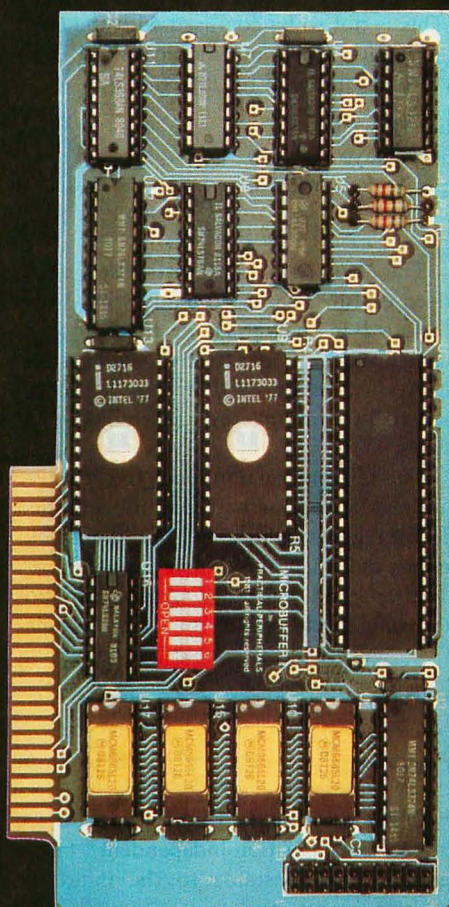
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PC-relative addressing). In these examples, the destination register could be Y, U, or S, instead of X, if desired. The destination for the TFR instruction could also be register D, which is accumulators A and B treated as one 16-bit register.

I question the usefulness of a WAI (Where Am I) instruction by itself, however. Apparently, Dr. Reddi would like to get the value of the 6502's program counter and then use this value to set up a table of addresses in page zero of memory, to be used with page zero indirect addressing (or, I shudder, to modify addresses within his program, such as jump and subroutine addresses). Adding a WAI instruction to the 6502 would help, slightly, with this rather clumsy method of making programs relocatable.

Much more is needed to make programs easily relocatable. The ideal situation would be to have code that runs at any address with no changes required. This is called position-independent code. The 6809 has the necessary instructions for such code. In addition to the LEAX (and LEAY, etc.) mentioned above, its instruction set includes branches (jumps), both conditional and unconditional, and subroutine calls with relative addressing. The relative address can be either 8 or 16 bits long, the latter allowing relative addressing anywhere within the 6809's address space. (Subroutine calls and unconditional jumps are also available with absolute addressing.) The presence of these instructions allows writing programs that can be run at any address with no changes (and with no need to set up a table of addresses or to modify the code at run time).

The WAI instruction by itself solves only a small part of the problem of being able to have position-independent code, code that will run unchanged at any address. Perhaps this is one reason it is not present in most computers. Most (or all) computers that have a WAI instruction, such as the 6809, PDP-11, 68000, and IBM 370, are also capable of position-independent code. I suspect that the 8086, Z-8000, and VAX 11/780 are also in this category.

Another reason for the absence of WAI in most microcomputers is that most 8-bit microprocessors were intended for use in dedicated controllers where there is no need for position independence or a WAI instruction.

One may note that the 6800 has a WAI instruction, namely:

	BSR	NEXT
NEXT	EQU	\$

This use of BSR (branch to subroutine), which uses relative addressing, pushes the address of the next instruction onto the stack, where it can be easily retrieved. (This is not to be confused with the 6800 instruction whose mnemonic is WAI. This WAI means "wait for interrupt.")

**Jim Howell**  
5472 Playa Del Rey  
San Jose, CA 95123

The "Where Am I?" instruction is indeed useful. That is probably why it was included in the design of the Motorola 6809 as the Load Effective Address, or LEA, instruction, and its use is not restricted to finding the current PC contents.

The LEA instruction loads the effective address of its operand into the specified 16-bit register, which may be either stack, either index, or the double accumulator. The operand must use the indexed addressing mode, which includes PC-relative. "Where am I?" could be coded:

HERE LEAX HERE,PCR

Assuming that you want HERE to be in the X register.

Other uses for the LEA instruction are addressing position-independent tables and adding constants to the indexable registers.

I recently read an article comparing the 6502 and the 6809 in which the author complained that he wasn't able to find much use for the LEA instruction. This caused some amusement among my friends. A close examination of some of my own code reveals that the LEA instruction is one of the most heavily used. I would venture the opinion that position-independent code would be much more difficult to write without it.

**Howard Lee Harkness**  
Word's Worth  
POB 28954  
Dallas, TX 75228

## Architecture Controversy

It was nice to see your article on higher-level machine-language constructs, "Should the DO Loop Become an Assembly-Language Construct?" by Glenn L. Williams (October 1981 BYTE, page 413). I would like to add a couple of comments to Mr. Williams's remarks.

Since Mr. Williams was including mini-computers in his article (he references the

PDP-11 and VAX 11/780) he might also have included a reference to the HP3000 instructions MTBA, MTBX, TBA, and TBX. These four instructions each perform a variation of Mr. Williams's NXT function. All the instructions use a loop variable, a limit value, and a step value. TBA and MTBA use a variable address on the stack while TBX and MTBX use the index register for the loop variable. In all cases, the limit and step values are on the stack. MTBA and MTBX modify the variable by the step value, which may be any integer, positive or negative, and compare the result to the limit value. Positive step values cause a check to see if the limit has been exceeded, and negative step values cause the check to see if the result is less than the limit. TBA and TBX do not modify the variable but check only for the limit being exceeded. These allow compilers to implement more complex counting-loop structures than can be accomplished by adding or subtracting a step size. Also, functions similar to Mr. Williams's SRCH function are performed by SCU (SCan Until memory byte matches test byte or terminal byte) and SCW (SCan While memory byte matches test byte or until terminal byte is found) on character strings.

With the growing acceptance of modular, structured programming it has long been my feeling that high-level constructs should be imposed at the machine-instruction level. The only real need for assembly language these days is to utilize the machine architecture not available at the high-level-language level to produce quick, short code. Implementing high-level functions in machine language and providing optimizing compilers should just about eliminate any need for assembly language. Code produced would be very short and quick, because a single complex machine instruction should run faster than the many simpler instructions put together needed to accomplish the same function. I would like to see both micro- and minicomputer processors developed with instructions to implement WHILE, IF . . . THEN . . . ELSE, CASE, DO . . . UNTIL, and other high-level constructs at the machine-instruction level.

Let's all keep pushing for advances in architecture to keep up with advances in software. And thanks, BYTE, for being among the leaders in this respect.

**David B. Mears**  
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## Letters

Glenn Williams is undoubtedly correct when he says that the instruction sets of microprocessors can be improved. For various reasons, however, I do not agree with his specific proposals.

It will always be necessary to write programs in assembly language, but if the "software crisis" can be solved at all it will only be by the efficient implementation of high-level languages. Processor designers have clearly realized this, but unfortunately their attempts at providing "features" that are supposed to help the compiler writer are often misguided. Consider, for example, two of the features mentioned by Mr. Williams: stack and condition registers.

There are two principal reasons for using stacks in the implementation of a high-level language. One is to save and restore environments when procedures are called, and the other is to provide fast temporary storage during expression evaluation. Typical PUSH and POP instructions do not help in either case: to save and restore an environment we need an appropriate addressing mechanism, and expressions can be evaluated faster using registers than stacks in memory.

If we were interested only in simple test-and-jump coding, condition registers would be fine, but in high-level language programming this is not always the case. The Pascal statements

```
finished := eof OR (lines > maximum)
```

and

```
total := total + width * length
```

have the same structure. On a processor with condition registers, however, the first is coded by means of an elaborate sequence of jumps, while the second is a simple sequence of arithmetic operations. There is no reason why tests should not leave their results in ordinary registers, like other instructions.

The DO statement that Mr. Williams proposes would not be used by any but the most sophisticated optimizing compiler. First, it is inappropriate for loops in which a termination test is made on entry to, rather than on exit from, the loop body. This is not required for FORTRAN, but it is for Pascal. Second, the DO stack must be adjusted if an exit occurs before the loop is completed, and that is often, whatever the structured-programming zealots say. Third, a special addressing mode is required so that the code within the loop can access the DO index, because

the DO index lives in the DO stack.

The real requirements have been accurately summarized by Professor William Wulf ("Compilers and Computer Architecture," *Computer*, July 1981): the compiler writer wants well-designed primitive instructions, not solutions to problems. A small set of efficient, useful instructions is better than a vast number of "clever" instructions that do the right thing in special circumstances but require elaborate analysis in the general case.

Peter Grogono  
Metonymy Productions  
4125 Beaconsfield Ave.  
Montreal, Quebec  
H4A 2H4 Canada

### SR51A vs. HP-41C Calculations Continued

I thank Mr. Kitchen (Letters, October 1981 BYTE, page 20) for another opportunity to discuss accuracy in Hewlett-Packard calculators. I fear he missed the point; please note my earlier statement regarding predicability (Letters, April 1981 BYTE, page 16). Then try this with an SR51A or a similar calculator:

1. Take the square root of 2. On both your SR51A calculator and my HP-41C, the display shows 1.414213562. Square this result. You get 2; I get 1.999999999. Subtract 2. Neither machine yields zero, but yours looks like it will, unless you "chisel out" the hidden digits first.
2. Enter 1.414213562 through the keyboard, then square it. If your display reads 2, feel free to be outraged: your machine does funny arithmetic. Indeed, the SR51A does not yield 2 as a result, but, considering what happened in (1), it looks like it will. How much work are you willing to do to discover how your calculator is going to behave? If it is really a 13-digit machine, why must you trick it to reap the benefits?

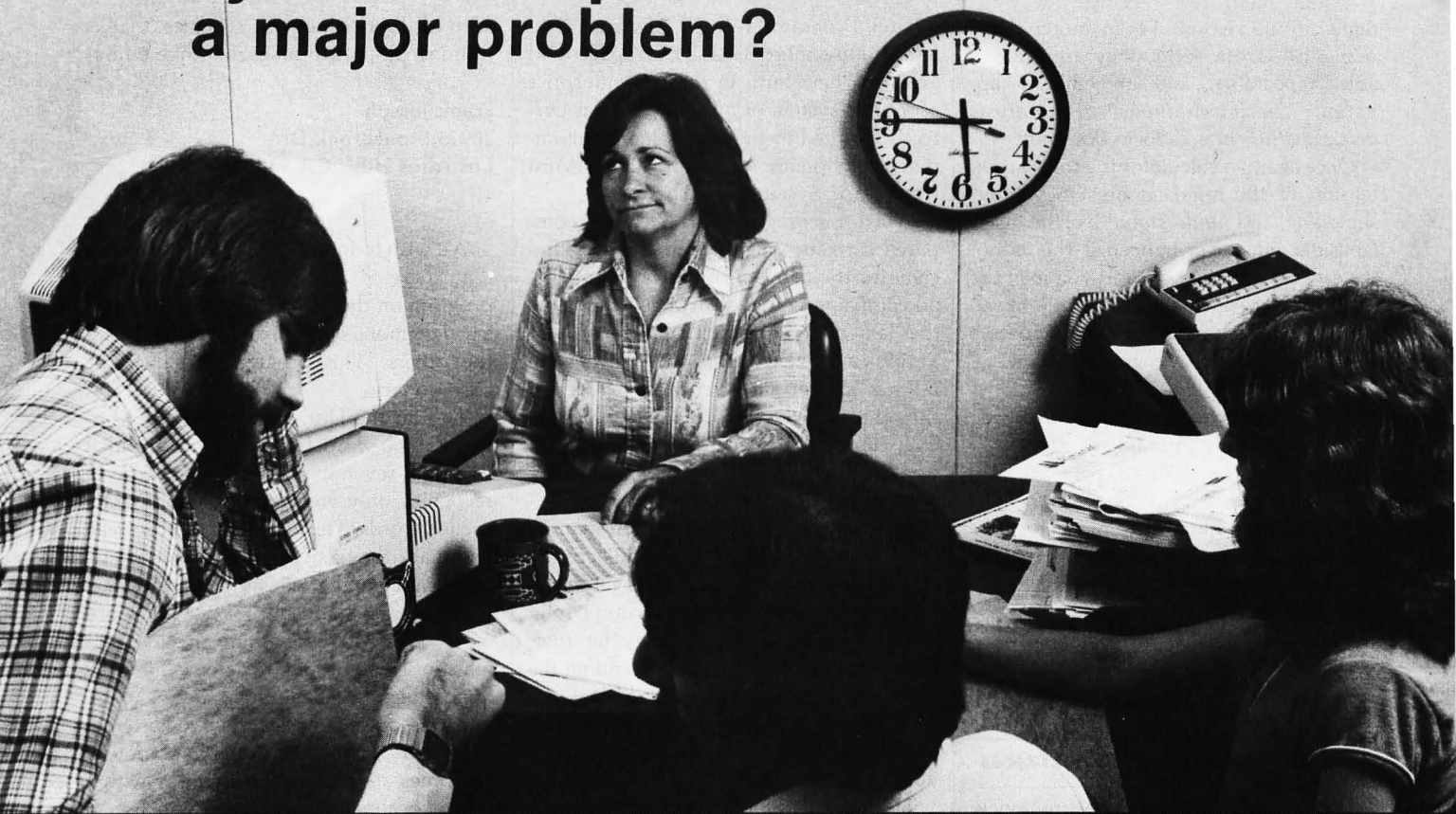
I could go on. At great length. And not just about SR51s and square roots.

In some cases, the SR51A yields better results than an HP-41C. *But which cases?* In chain calculations, digits 11, 12, and 13 can become numerical noise that creeps into the visible mantissa, causing mysterious results whose origins are very hard to isolate.

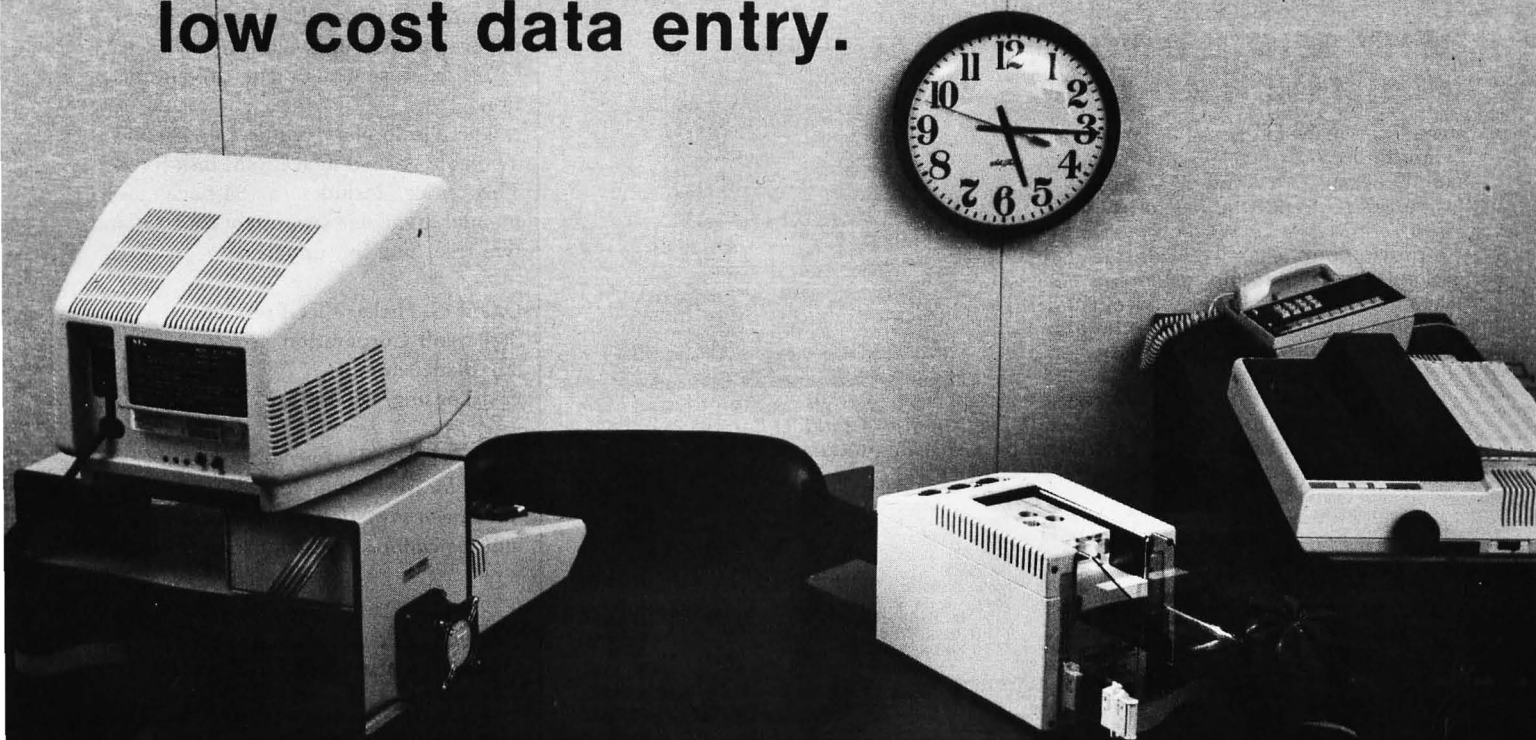
Hewlett-Packard calculators exhibit more deterministic behavior. Accurate internal software that discards guard



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## Letters

digits is one reason. When unavoidable numerical errors occur, they are predictable, repeatable, and immediately apparent. *Serious numerical analysis demands this*; braggadocio does not.

Once again: a calculator is a tool, an extension of the mind. It must be *understandable* and *understood* by the user. Consider what can happen if this is not the case for a variety of tools you may use (e.g., power saws, guns, automobiles). Then consider who uses calculators seriously: scientists, engineers, bankers, and doctors.

The designers at Hewlett-Packard keep such things firmly in mind.

Steve Abell

Research & Development Engineer  
Hewlett-Packard Company  
Corvallis Division  
1000 NE Circle Blvd.  
Corvallis, OR 97330

### The Big Spelling Sweepstakes

The spelling-correction software review by Phil Lemmons ("Five Spelling-Cor-

rection Programs for CP/M-Based Systems," November 1981 BYTE, page 434) gives me new faith in the free-enterprise economic system of business. He has correctly pointed to the best value in a computer dictionary program: The Word from Oasis Systems.

When this program was released I compared it to the "high-priced spreads" and came to the conclusion that a big-budget ad campaign would always get results for the less-valued product. The way that various magazine editors and writers were talking up certain overpriced spellers I thought that the big dollars would win over the underfinanced little organizations. I concluded I was wrong after reading your comprehensive review.

I'm sure there's a lot of egg on many a face this day—and rightly so. There are always some individuals willing to lend their names to products they don't fully understand. Furthermore, they let their names to be used without understanding the competitive positions they are taking. That seems to be a characteristic of our culture—if action is required, act even if you don't have the facts.

The time is rapidly approaching when the fast-buck artist can no longer get away

with his "get-rich-quick" schemes, thanks in no small part to magazines like yours.

Frank Joseph

10925 Stonebrook Dr.  
Los Altos Hills, CA 94022

We wish to inform BYTE and its readers that there is a sixth spelling-correction program on the market that, according to Mr. Lemmons's benchmarks, outperforms the others. This program is called the Disc-tionary.

We ran the Disc-tionary on Mr. Lemmons's 400-word benchmark text and it found all seven misspellings, yet failed to recognize only eight additional correctly spelled words. The total time to proofread and mark the file was only 47 seconds on a typical computer when the word review feature was skipped (1:12 with word review). A 3100-word file can be proofread in 1:12 without review. While it is impossible to make direct timing comparisons due to the use of two different computers, the Disc-tionary obviously combines a high level of accuracy with a large vocabulary. This gives the user a higher level of safety and convenience than the other programs.

We believe that the Disc-tionary presently provides the best combination of speed and accuracy. It is also very easy to use because of its menu-driven operation.

The Disc-tionary requires a Z80 and is available on an 8-inch CP/M disk for \$79. This price includes a 54-page user's manual (available separately for \$15) and two free "bug fix" updates.

David G. Hicks, Vice-President

Stellarsoft Corporation  
841 Blanchette Dr.  
East Lansing, MI 48823

**Editor's Note:** This program has not been tested by Mr. Lemmons. The times above have been provided by the manufacturer, and we cannot vouch for their accuracy.

### An Avalanche of Answers

I have received some pretty strange and fascinating responses to a question I put to Steve Ciarcia that was printed in "Ask BYTE" (July 1981 BYTE, page 218).

Apparently, Steve didn't provide what the readers thought was the best answer and they quickly let us both know. The

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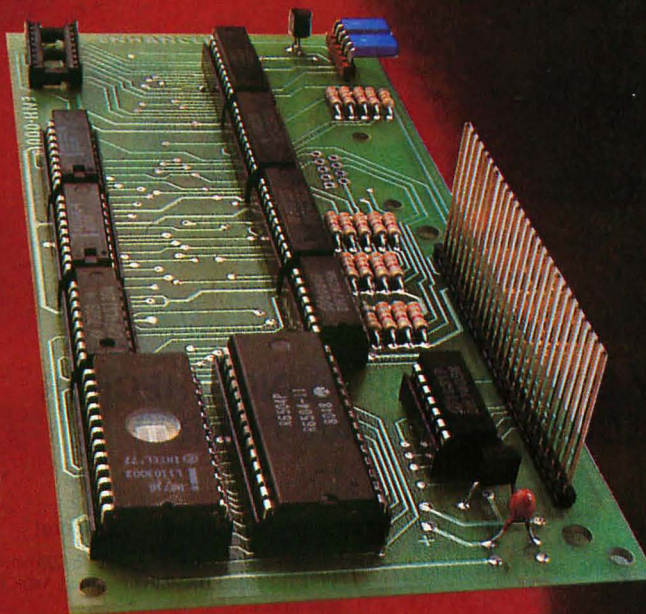
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# THE DAWN OF A NEW ERA FOR APPLE II: THE ENHANCER II

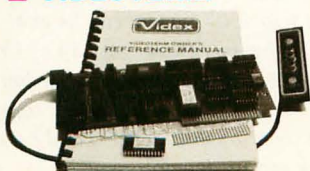
Introducing the Enhancer II: a new Standard which is improving the relationship between Humans and Apples. The Enhancer II can help your Apple II's keyboard become more sociable by remembering words or phrases which can be entered into the Apple by the mere touch of a key. Life can become even easier because the Enhancer II can remember what you typed while your Apple was busy talking to your disc (or doing other things).

Naturally, it knows the difference between upper and lower case letters and what shift keys are supposed to do. It even knows to auto repeat any key held down. The Enhancer II replaces the encoder board making installation simple.

Suggested retail price: \$149.00.



## VIDEOTERM

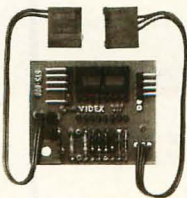


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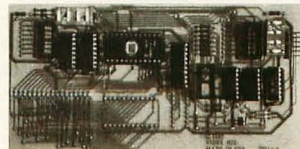
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The Soft Video Switch is an automatic version of the popular Switch-plate. It knows whether it should display 40 or 80 columns or Apple graphics. It does the tedious work of switching video-out signals so you don't have to. The Soft Video Switch can be controlled by software. Any Videoterm with Firmware 2.0 or greater may be used with the Soft Video Switch. The single wire shift mod is also supported. Package price is \$35.00.



## KEYBOARD AND DISPLAY ENHANCER



The original Keyboard and Display Enhancer is still available for Revision 0-6 Apples (on which the new Enhancer II will not fit). These Apples have memory select sockets at chip locations D1, E1 & F1. The Keyboard and Display Enhancer allows entry and display of upper & lower case letters with fully functional shift keys. It does NOT have user definable keys nor a type ahead buffer. The price is \$129.00.

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- Applesoft Read Screen Utility
- Top & Bottom Scrolling
- Pascal Vidpatch
- Graphics Template

Character Set EPROMs \$29.00 ea

- Half Intensity
- Inverse
- German
- Katakana (Japanese)
- Line Drawing Graphics (Expanded)
- Spanish
- French
- Math & Greek Symbols
- Super & Subscript

Dvorak EPROM (Enhancer) \$29.00  
Lower Case Chip \$29.00



## Letters

day I got my magazine I also got a long-distance call asking if I was Dave Bower and if I owned a TRS-80 and if I had written to BYTE magazine. The caller then answered my question. The next day I got a letter answering the question. There's nothing strange about getting a letter, except that you didn't print my address, and neither did the person sending the letter! And it continued like that for the next couple of months—letters and phone calls from all over the United States. And just when I thought it was over I got a package from Steve Ciarcia containing the letters he had received!

So, needless to say, I got my question answered. And I got a lot more too. I think every person that contacted me also shared more hints and/or information or whatever. So even though they all called or wrote me about the same thing, not one exchange was a waste of time.

I just wanted to let you know what kind of readers you have and that I think Steve has a pretty good column, and a well-read one too.

**Dave Bower**  
741 Lake Edward Dr., Apt. 104  
Virginia Beach, VA 23462

## Closing the Net

Harry Saal's article on local networks ("Local-Area Networks, Possibilities for Personal Computers," October 1981 BYTE, page 92) did injustice to your readers with its narrow scope and omissions. Specifically:

1. Datapoint's local coaxial network-based ARC system was introduced and installed in 1977.
2. About 2000 ARCs are installed and in commercial service worldwide—more than all other networks, prototype or otherwise, combined. (I have heard no argument to estimates that Datapoint has a 95 percent market share of installed local networks.)
3. Tandy uses the local network portion of ARC, ARCNET, for its TRS-80 Model II personal computer network, announced in September—a step of major significance.
4. Three companies now use ARCNET—Datapoint, Inforex, and Tandy.
5. The only deliverable chip-based local network interface is manufactured by Datapoint.

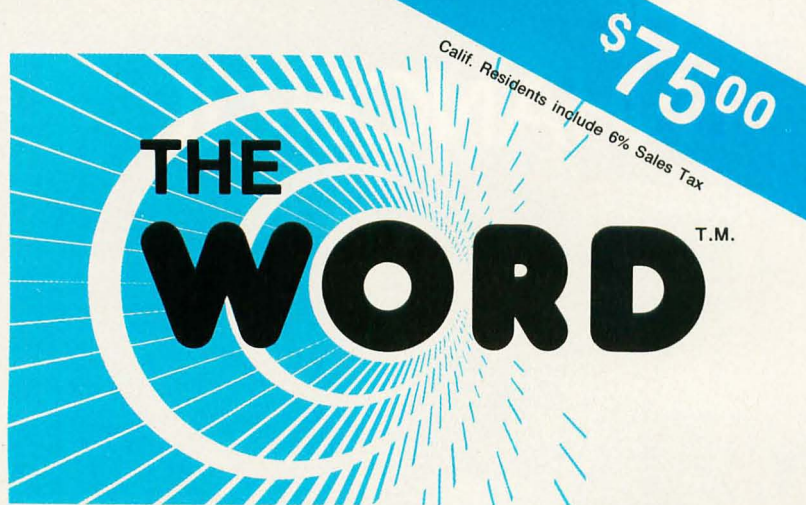
Considering these omissions, I'm skeptical that the article was well researched.

**Gerard Cullen**  
Vice-President Marketing  
International Operations  
Datapoint Corporation  
9725 Datapoint Dr.  
San Antonio, TX 78284

### Harry J. Saal replies:

*My article was not intended as a complete survey of local-area network products. Datapoint's offerings in the high-speed, serial, coax network were indeed quite early; it is unfortunate that Datapoint has not provided any in-depth technical information in the published literature by which its system can be evaluated for comparative study. In September 1981, several months after my article was completed, Datapoint announced its relationship with Tandy, a very exciting recent development.*

*Let me assure Mr. Cullen that there are substantially more than 100 installed, non-ARC local networks worldwide; hence the 95 percent market share claim is false. ■*



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## **The Connector Also Transmits and Receives Electronic Mail.**

The Context Connector also serves as a basic communications program. The Connector has an auto-dial feature to automatically call other

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## **Specifications.**

The Connector is designed to work with the Apple II, 48K of RAM and at least one disk drive. The Connector supports both 13 and 16 sector disk versions of VisiCalc. It also works with the Apple III in emulation mode.

For data transmission, the Connector supports the D.C. Hayes Micromodem, Apple communications card or the SSM/AIO card.

## **Available at Your Local Computer Store.**

The Connector is available at most personal computer stores. For the name of your nearest dealer, please call or write Context Management Systems. Retailers, the Connector is available from Softsel Distributors or from Context Management Systems.

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Send us a blank 5¼" disk and a self addressed stamped mailer and we'll return your disk with a copy of the Connector demonstration program which explains how you can use the Connector. Or if you prefer, send a check for \$4.00 made out to Context and we'll send you a new Maxell MD-1 5¼" disk containing our demo program. Once you've seen our demo, you can delete the program and use the demo disk as you would any new blank diskette. It's a risk free way of seeing the Connector demonstrated on your Apple.

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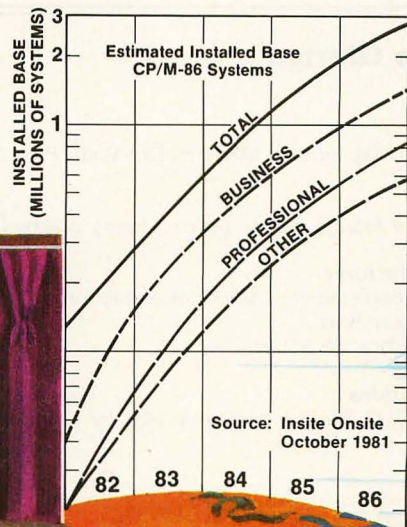
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## Commodore 4022 Printer

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Joseph Holmes  
13049 Broadway Terrace  
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Some marriages are made in heaven—others are made in Japan. Commodore Business Machines has joined Epson to produce a fine, low-

cost printer that combines the hardware features of the Epson MX-80 with the upgraded operating system of the Commodore CBM 2022

printer. Latest in a series of new products from Commodore, the CBM 4022 will handle most printing jobs where the 8½- by 11-inch paper size and dot-matrix output are acceptable.

The 4022 is totally compatible with all Commodore 2000, 4000, and 8000 series computers. The printer requires no special interface other than a cable. The 4022 prints the entire CBM/PET character set (256 characters), which means that listings and graphics programs come out just as they were entered (see figure 1). It is controlled by an internal microprocessor, which gives the 4022 versatile line-spacing and formatting capabilities. You can design your own business forms; you can even design and print special characters. The 4022 has both a replaceable line cord and an external, easily replaceable fuse.

In order to detail the other features of the CBM 4022, I will compare it to its cousin, the MX-80, and to its father, the CBM 2022.

### CBM 4022 Versus Epson MX-80

Many of the 4022's features overlap those of the MX-80. Both have a self-diagnostic print test and lowercase descenders (one-dot descenders with the 4022 and two-dot descenders with the MX-80). Line spacing defaults to 1/6 inch (six lines per inch) in the 4022 and to either 1/8, 1/6, or 7/72

### At a Glance

**Name**

Commodore Business Machines Dot-Matrix Printer Model CBM 4022

**Use**

General (listings, reports, business forms, graphics, draft-quality word processing, etc.)

**Manufacturer**

Commodore Business Machines and Epson  
3330 Scott Blvd.  
Santa Clara, CA 95051

**Dimensions**

10.7 by 37.3 by 33 cm (4¼ by 14¾ by 13 inches); the weight is 6.6 kg (14.6 pounds)

**Price**

\$795

**Additional Hardware Needed**

Cable (CBM to IEEE-488 or IEEE-488 to IEEE-488)

**Features**

Disposable heavy-duty 8-wire jeweled print head, cartridge ribbon, 80-column width capability, 5 by 8 dot-matrix characters (6 by 8 for graphics), true lowercase descenders, maximum print speed of 80 lines/minute for 20 columns (40 lines/minute for 40 columns), programmable line spacing, user-designed characters, paging with variable lines/page, enhanced (widened) characters, two character sets, and built-in error messages

**Documentation**

Commodore User's Manual, 45-page paperback (supplied with printer); Osborne/McGraw-Hill PET/CBM Personal Computer Guide, 2nd edition, 501-page paperback (supplied with computer)

**Audience**

Programmers, businesspeople, engineers, educators, students, writers, hobbyists, or others with Commodore 2000, 4000, or 8000 series microcomputers.





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by James Farvour

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```

CBM 4022 PRINT SAMPLE
*****

```

@!"#\$%&'()\*+,-./:;?@ABCDEFGHIJKLMN,;?789/456\*123+0.-=

@! "\$% '&\*() +,-./:;?@ [ \ ] ^ \_ ` { | } ~ ! @ # \$ % & \* ( ) - =

4. 7. 8. 9. 0 [ ] QWERTYUIOP↑ ▯ ASDFGHJKL↘ZXCVBNM ▯. , - \_ | { } ~ =

ENHANCED: ONCE--TWICE--THREE--

**Figure 1:** Print sample of the Commodore CBM 4022 printer showing the entire character set, reversed and enhanced print, and user-defined characters.

Characters printed by the 4022 can be enhanced (widened). This can be done several times, if desired. Print enhancement with the MX-80 means emphasized print and/or double striking; both processes make the characters closer to correspondence quality. The 4022 is a tractor-feed printer that accepts paper in 4- to 10-inch widths. The print head is disposable, has a useful life of from 50 to 100 million characters, and costs less than \$30. (Another disposable print head, which is longer

In printers, as in marriage, compromises often must be made. In order to accommodate the versatile CBM operating system, the 4022 has missed some of the juicier features of the MX-80:

- The MX-80 prints 10 characters per inch (cpi) at 46, 73, and 105 lines per minute for 80, 40, and 20 columns, respectively. The corresponding print speeds for 10 cpi with the 4022 are 30, 50, and 80 lines per minute.

- The MX-80 has 12 printing modes that combine four character-width sizes: *normal*, 10 cpi; *normal double width*, 5 cpi; *compressed*, 16.5 cpi; and *compressed double width*, 8.25 cpi with four print densities: *standard*, *emphasized*, *double strike*, and *emphasized plus double strike*. Epson's MX-80 prints all these combinations of print sizes and print densities—except *enhanced* and *enhanced plus double strike* for the two *compressed* sizes.

- The four type sizes used by the MX-80 give a range of 40 to 132 characters per 8-inch line. The CBM



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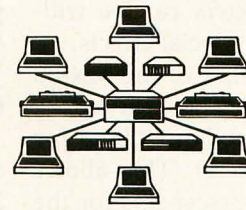
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4022 has one print mode and one type size giving 10 cpi or 80 characters per 8-inch line. Characters can be widened, however, for special effects.

- The character matrix of the MX-80 is 9 by 9 dots, whereas that of the CBM 4022 is 6 by 8 dots (5 by 8 for nongraphic characters). This allows two-dot lowercase descenders for the MX-80 versus one-dot descenders for the CBM 4022.

- The MX-80 has four indicator lights: Power On, Printer Ready, Paper Out, and On Line. The four switches on the MX-80 are Power On/Off, On Line, Form Feed, and Line Feed. In addition, a warning buzzer responds to paper-out and error conditions. The CBM 4022 has one indicator light (Power On), which also flashes for paper out, and two switches: an On/Off switch and a Paper Advance button that takes you to top-of-form or feeds continuously if held down.

- The MX-80 lists for \$645; the CBM 4022 lists for \$795. Since no addi-

tional interface board is needed to connect to PET/CBM computers, you could come out ahead with the 4022.

### CBM 4022 Versus CBM 2022

How does the CBM 4022 stack up against its predecessor, the CBM 2022? Physically, they are quite different. The 4022 is lighter and far more compact. It is also much quieter—a plus for the families of nighttime programmers! The 4022 has true lowercase descenders; the 2022 does not.

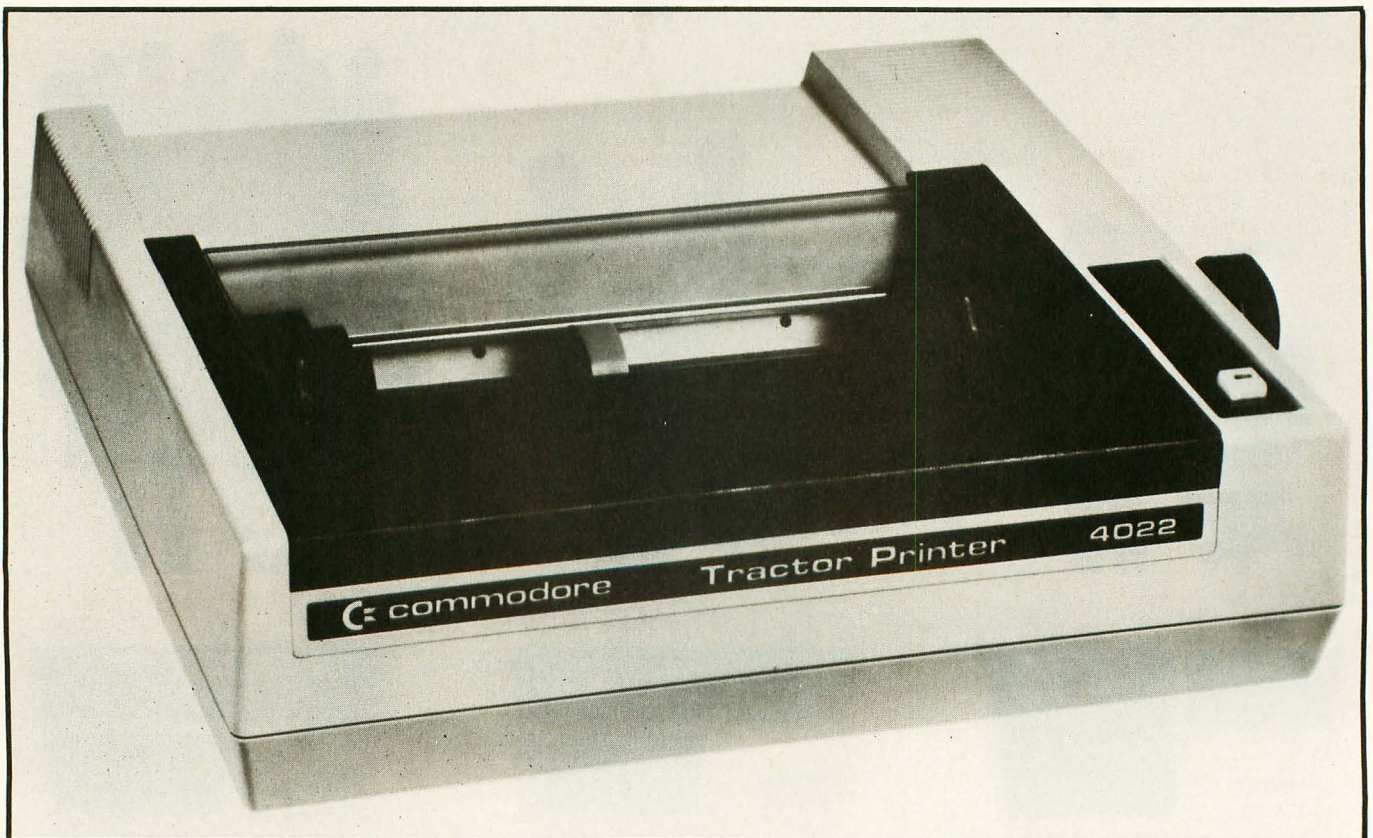
Both printers share a slightly annoying bug. When in the lowercase mode, the *backslash*, the *left arrow*, and the *up arrow*, and the *left* and *right brackets* must be shifted to achieve their normally unshifted appearance. For their shifted versions, or graphics, you must type them unshifted. I have learned to live with this. The earlier model's paper advance couldn't find the top-of-form, but it was useful for advancing the

paper short distances without turning the knob. The new model makes it more difficult to back up the paper without crinkling precious hard copy.

Both CBM printers have formatting and other features that are controlled by a system of *secondary addresses (sa)*. These features are activated by opening *files (channels)* to one or more of the secondary addresses and then printing to the appropriate file. The earlier model 2022 had these seven secondary addresses:

- sa 0: Print exactly as received
- sa 1: Print according to an established format
- sa 2: Establish format field
- sa 3: Set number of lines per page
- sa 4: Activate error messages
- sa 5: Design custom character
- sa 6: Set spacing between lines

The later model 2022 added an eighth secondary address (*sa 7*) that switched the entire PET/CBM character set from uppercase/shifted



**Photo 1:** Manufactured in Japan by Epson, the new CBM 4022 combines the hardware features of the MX-80 with the upgraded operating system of the CBM 2022 printer.





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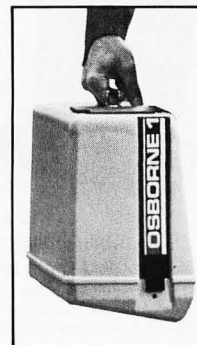
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graphics to lowercase/shifted uppercase. However, this upgrade had one nasty bug. Often, when another secondary address was accessed, the character set would switch inexplicably to lowercase. The only remedy for this was to reset the printer by turning it off and then on again. The CBM 4022 has overcome this problem with the addition of three more secondary addresses: numbers 8, 9, and 10—for a total of 11. Secondary address 8 switches the printer back to uppercase mode. Secondary address 9 closes the channel to *sa* 4, the error channel, and *sa* 10 resets the printer so that only *sa* 0 (the default channel) is left open. These new addresses allow much better and more reliable direct keyboard and software control of printer functions. The last four secondary addresses for the CBM 4022 are:

- sa* 7: Switch to lowercase
- sa* 8: Reset to uppercase
- sa* 9: Turn off error channel
- sa* 10: Reset everything

Let's look at some of the 4022's features in more detail. If a file (channel) has been opened to *sa* 1, all printing will be in a format that was previously established. This format was set up by opening file *sa* 2 and then assigning a format field (or image string) to a string variable, then printing that string variable to the file open to *sa* 2. The format field that governs output layout is similar to the image fields used in the PRINT USING command found in some versions of BASIC.

Here are a sample PRINT statement, a format field, and the formatted printout. (The values of the variables used are A\$ = "OK", A = 37, B = 86, C = 8.27, D = 1.28, E = 1.25, F = 26.51, G = -3, H = -3.) The PRINT statement is:

```
PRINT#1,"A$CHR$(29)CHR$(160)
CHR$(29),A,B,C,D,E,F,G,H"
```

The format field for this PRINT statement is:

```
AAAA AAA ZZZZ R| 9999R|
99.99 ZZ.99 $99.99 $$$9.99 S99 99-
```

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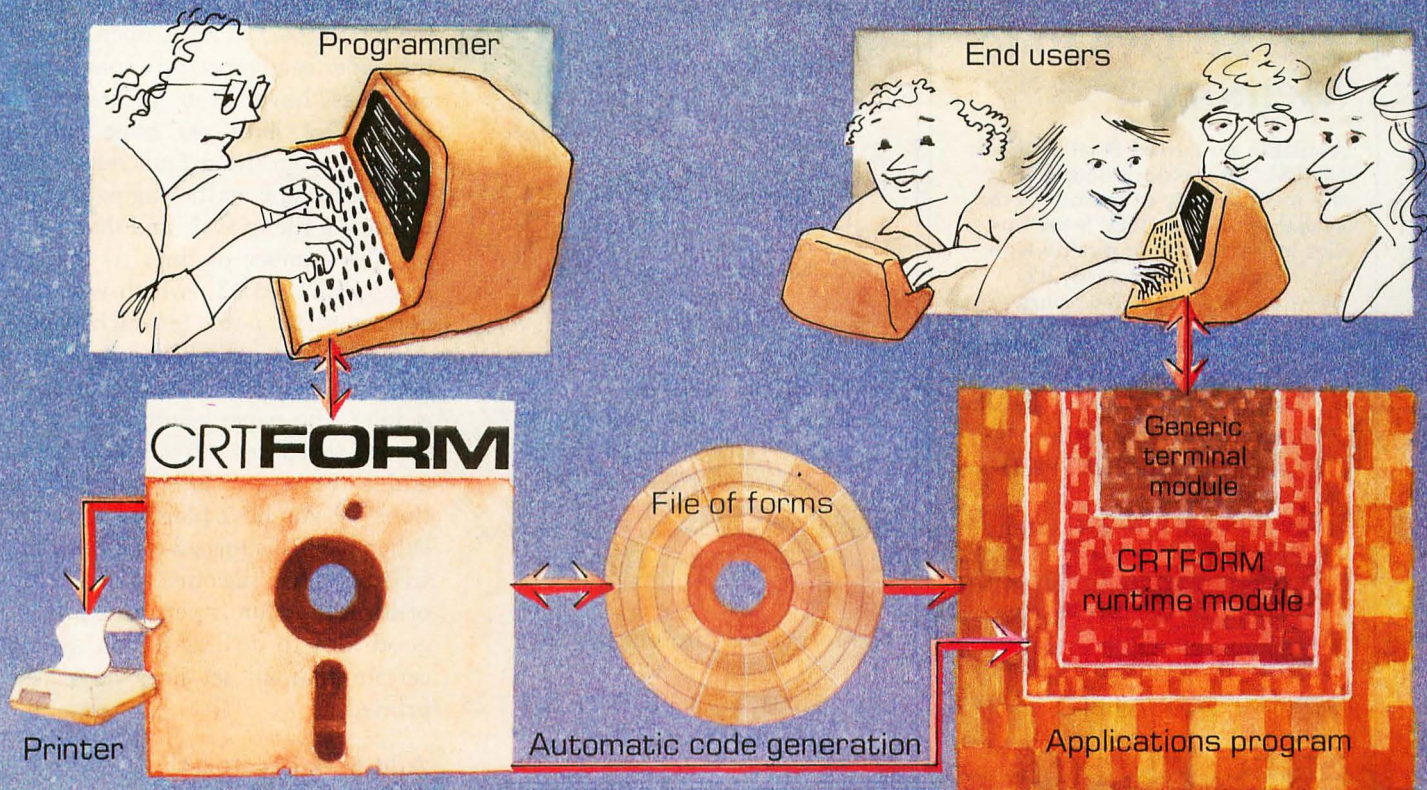
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```
LOOSER  +++| | | |
LINE      +++| | | |
SPACING  +++| | | |
3 LINES PER INCH
```

```
TIGHTER  +++| | | |
LINE      +++| | | |
SPACING  +++| | | |
8 LINES PER INCH
```

```
NORMAL   +++| | | |
LINE      +++| | | |
SPACING  +++| | | |
6 LINES PER INCH
```

Figure 2: Three examples of the line spacing available with the CBM 4022.

The formatted printout is:

```
OK      0037 | 86| 8.27 01.28 $ 1.25
          $26.51 - 3 3-
```

The CHR\$(29) in the PRINT statement is a string delimiter that assigns spaces to the right of a string equal to the number of spaces in the format field to the right of the alpha (string) field. The As represent characters in a left-justified alpha field and are *right padded* with blanks, if necessary. The CHR\$(160) prints the first character of the next alpha field as a blank and then right pads the rest of the alpha field with blanks. Otherwise, CHR\$(160) will add an extra space, as well as convert unshifted leading spaces in a string to shifted spaces. A shifted space in a string will be accepted as a space for formatting.

The other symbols are numeric. The 9s are digits in a right-justified field and are *left padded*, if necessary, with blanks. Zs act like 9s, except blanks are left padded with zeros. A single \$ next to a 9 or Z gives a fixed dollar sign, whereas using all \$s up to the decimal gives a floating dollar sign. S prints the sign of a number to its left (-12, +15); the - sign prints the sign of the number to its right: a blank if positive, and a - if negative. Literals such as vertical bars

can be embedded in the format field. These embedded literals are useful in creating special forms as a part of the printout.

When paging is turned on by printing CHR\$(147) to a file open to *sa 0*, the paper is advanced six spaces after 60 lines have been printed. The number of lines per page can be changed from the default number 66 by first turning on the paging feature, opening a file to *sa 3*, and then printing the number of lines to that file (e.g., PRINT#3,33—which would be correct for 8½- by 5½-inch paper). After 27 lines have been printed (six less than the 33 set by *sa 3* in this example), the paper automatically advances six spaces: three spaces before and three spaces after the perforations—if you have planned correctly. When paging is turned off by printing CHR\$(19) to a file open to *sa 0*, a top-of-form function is performed. It is a good idea to do this if you are not certain that all set lines have been printed.

### Additional Features

Six diagnostic error messages can be accessed by opening a file to *sa 4*:

- \*PE:L\* Lines per page out of range
- \*PE:C\* Bad command (invalid secondary address)
- \*PE:M\* Data-format mismatch
- \*PE:E\* Exponent error
- \*PE:F\* Bad format
- \*PE:T\* Terminator error (change of *sa* before carriage return or other terminator detected)

This error channel can be turned off by opening a file to *sa 9*, printing to that file, and then closing the file.

The *User's Manual* gives a method for designing custom characters that should be changed to the following: Fill in a 6 by 8 matrix with dots where you like. Each row in this matrix is assigned a value that is a power of two from 1 (bottom row) to 128 (top row). The dot values are added for each of the six columns, assigned a CHR\$ value, and then printed to a file open to *sa 5*. This character can be printed as CHR\$(254).

Opening a file to *sa 6* allows you to change the normal spacing of 6 lines



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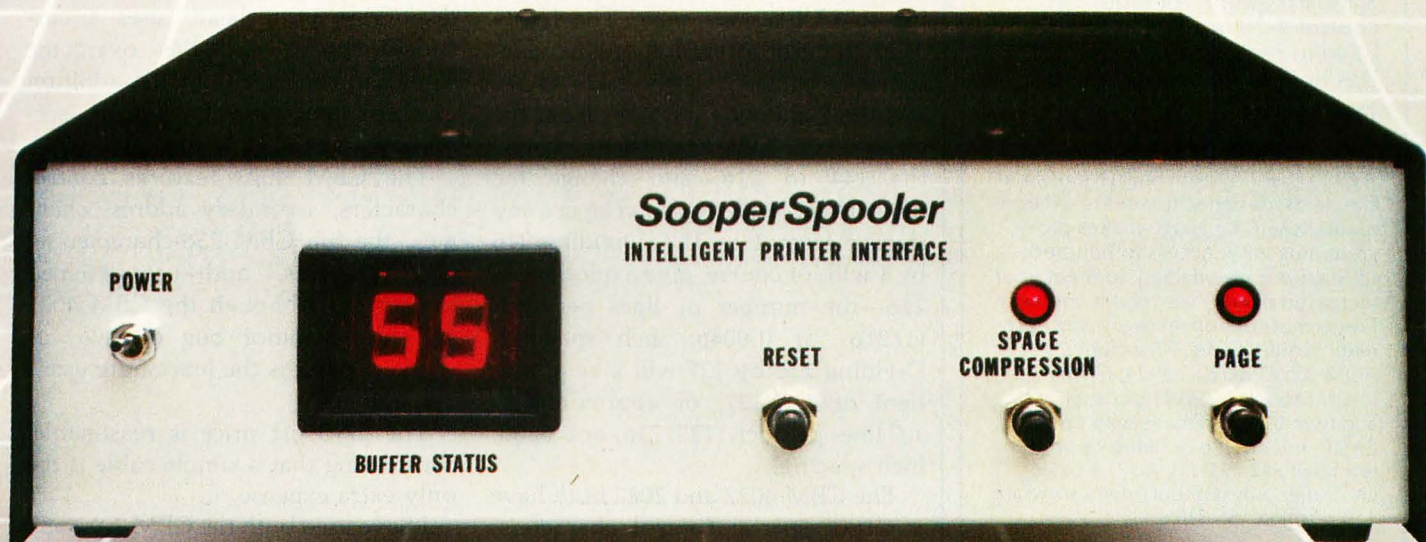
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Function	CHR\$ Value	Keystrokes
Enhance On	CHR\$(1)	none
Enhance Off	CHR\$(129)	none
Paging On	CHR\$(147)	CLR/HOME (shifted)
Paging Off (Reset)	CHR\$(19)	CLR/HOME
Reverse Field On	CHR\$(18)	OFF/RVS
Reverse Field Off	CHR\$(146)	OFF/RVS (shifted)
Carriage Return	CHR\$(13)	RETURN
Carriage Return (no feed)	CHR\$(141)	none
Line Feed	CHR\$(10)	none
Uppercase	CHR\$(145)	CURSOR UP *
Lowercase	CHR\$(17)	CURSOR DOWN *
Skip Space	CHR\$(29)	CURSOR RIGHT
Insert Leading Blanks	CHR\$(160)	SPACE (shifted)
Quote	CHR\$(34)	Quote ("') **

\* These functions are reversed if sa 7 is in effect.

\*\* This can be a forced quote within a PRINT statement. Also, an odd number of quotes allows control characters to be printed in their graphics form.

**Table 1:** Control characters sent through secondary addresses 0 and 1.

per inch (see figure 2). To do so, you must choose a divisor for 216 that will give a quotient that is the number of lines per inch that you want (default = 36 for 6 lines per inch): 18 yields 12 lines per inch and is nice for graphics that normally get too stretched out vertically when printed; 24 yields 9 lines per inch, but some graphics with this spacing are still too stretched out. If you want normally spaced text and somewhat compressed graphics, you can leave an extra space between text lines in your program and then change your spacing to 12 lines per inch. The *User's Manual* needs a revision on line spacing. The values given on page 31 are incorrect; they are left over from the model 2022. To correct them, change the 144 to 216, and change the divisors accordingly. You can use any divisor from 1 to 127. Dividing 216 by 1 will, of course, give a quotient of 216—the number of lines per inch (1/216, or 0.0046, inch spacing). Dividing 216 by 127 will give a quotient of 216/127, or approximately 1.7 lines per inch (127/216, or 0.5880, inch spacing).

The CBM 4022 and 2022 both have a set of special control characters. Their functions and equivalent keystrokes are listed in table 1.

To get more information on the use of these controls plus the other features of the CBM 4022, consult either the *Commodore User's Manual* or the appropriate sections of the *Per-*

*sonal Computer Guide*, 2nd edition, published by Osborne/McGraw-Hill.

### Conclusions

The CBM 4022, manufactured by Epson for Commodore, is the dot-matrix printer of choice for users of PET/CBM computers because of the Commodore specificity of its operating system. It compares well with its cousin, the Epson MX-80.

This printer is an improvement over the earlier CBM 2022 because it has true lowercase descenders; is quieter; has an inexpensive, disposable print head; uses a cartridge ribbon; and has overcome some serious bugs with the addition of three new control channels (secondary addresses).

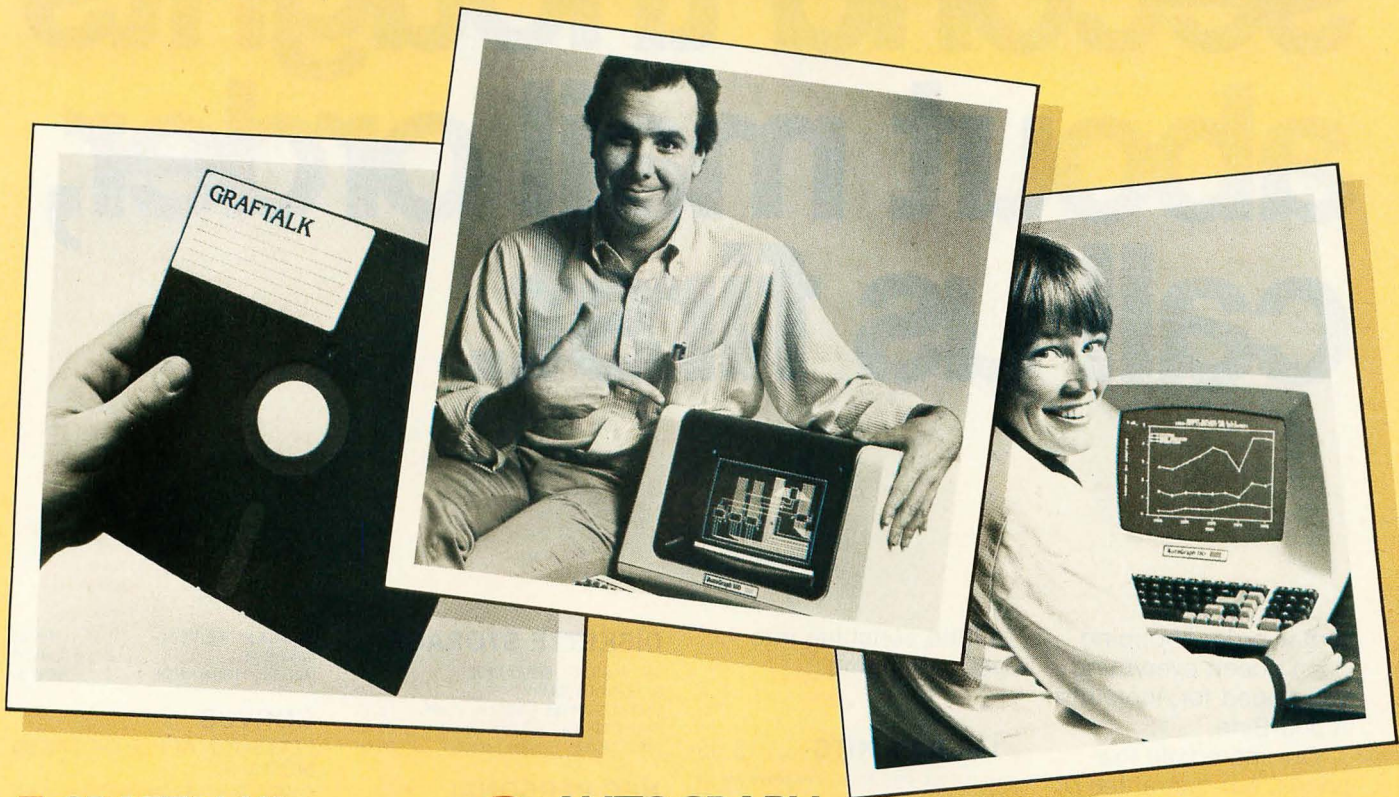
The CBM 4022 features control characters, secondary address channels, the full CBM 256-character set with graphics, and user-designed characters. Although the CBM 4022 still has a minor bug or two, its weakest point is the inaccurate user's manual.

The \$795 list price is reasonable, considering that a simple cable is the only extra expense.

I have used both the CBM 2022 and the new CBM 4022 printers during the last year. Although most of my time has been spent with the earlier model, I am very pleased with the upgraded version as it has worked well for me. I enthusiastically endorse the Commodore CBM 4022 printer. ■



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# Four New Products from Radio Shack

by Chris Morgan

It was Christmas all over again on January 19 at Radio Shack in Fort Worth, Texas, where a quartet of major new products was unveiled during a day-long session. Some of the announcements were expected. Others were surprises.

## The TRS-80 Model 16: Two Computers in One

The most significant announcement was for the new TRS-80 Model 16 computer, which contains a Motorola M68000 processor (see photo 1). Externally, the unit looks like

the TRS-80 Model II (in fact, the case is virtually identical to the Model II's), but the front bezel has been redesigned to accommodate either one or two slim-line 8-inch drives. Two of these drives fit into the same amount of space as a single, standard-width drive. The big surprise is that Model II owners will be able to convert their machines to Model 16s by adding two printed-circuit boards that together cost \$1499. But there's one limitation: the maximum RAM (random-access read/write memory) on the upgraded Model II system is

256K bytes, whereas the Model 16 allows the user up to 512K bytes of RAM on board.

The Model 16's most important feature is its built-in Z80 coprocessor with 64K bytes of its own memory that allows the user to run all existing Model II software. Radio Shack's simple but clever idea is to free up the 68000 processor by using the Z80 for disk and I/O routines. This has to be one of the most elegant answers to the question of 8- and 16-bit compatibility. The operating system (Radio Shack's own design) boots up like the Model II, but automatically enters the 16-bit mode. A simple keyboard message from the user switches the system to the Z80 mode.

## Floppy Disks and Hard Disks

The slim-line floppy-disk drives are double sided and double density, with slightly more than one megabyte capacity each (formatted). Normally, a user would get only one floppy-disk drive for operating the Model 16 with a Radio Shack 8-megabyte hard-disk unit. Such a configuration (with the maximum 512K bytes of RAM) costs \$11,191—a bargain. By comparison, the least-expensive configuration, featuring 128K bytes of RAM and one disk drive (no hard disk), costs \$4999. This certainly gives the IBM Personal Computer some competition. (It should be kept in mind that the Model 16 lacks some of the IBM's features, such as color graphics.)

The announcement of the TRS-80 Model 16 gives the 68000 processor a firm footing in the 16-bit sweepstakes. (Can Apple be far behind with its 68000 design?) It's safe to say that the 16-bit era is underway.



**Photo 1:** Radio Shack enters the 16-bit market with the Model 16. While cosmetically very similar to the Model II, the Model 16 contains a Motorola 68000 processor and can address up to 512K bytes of memory. Two slim-line 8-inch floppy-disk drives can be installed in the same space occupied by one standard-width drive. When used in conjunction with Radio Shack's 8-megabyte Winchester hard-disk drive, one drive is sufficient. The Model 16 also contains a Z80 processor. Though normally used for disk I/O, the Z80 is employed in a Model II emulation mode and addresses its own 64K-byte memory. Upon booting up, the Model 16 automatically enters the 16-bit mode. A few simple commands place the machine in Model II emulation mode.



### An Updated Pocket Computer

The PC-2 Pocket Computer is an improved version of the current TRS-80 Pocket Computer, now known as the PC-1. Like the PC-1, the PC-2, shown in photo 2, is manufactured for Radio Shack by Sharp, in Japan, and features a built-in real-time quartz clock; a 7-by-156 dot-matrix liquid-crystal display; an 8-bit processor operating at 1.3 MHz; a new extended BASIC package with two-dimensional arrays, built-in arithmetic functions, and variable-length character strings; a four-color printer-plotter/dual-cassette interface (more about this later); and a 60-pin I/O con-

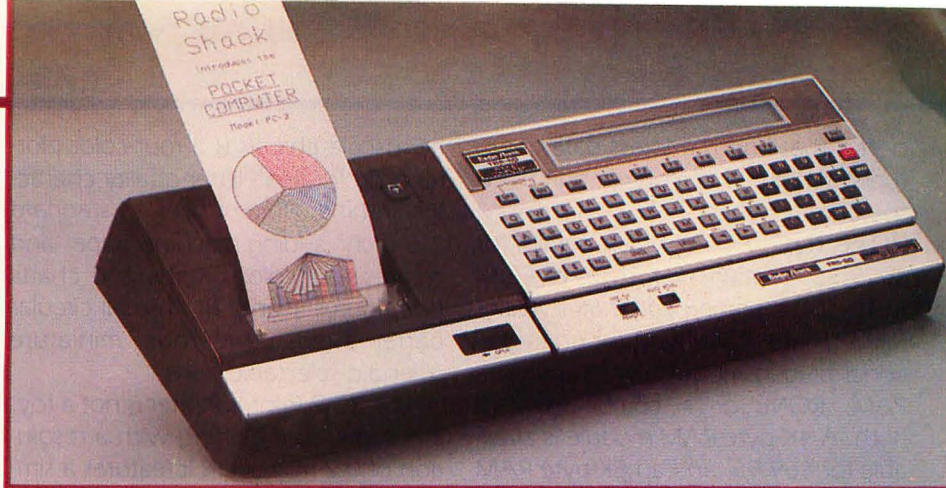


Photo 3: Though cosmetically similar to the Model III, the DT-1 video terminal uses the same monitor section as the Model II. Communication is through an RS-232C port, and both serial and parallel printer ports are provided. Transmission rates of from 75 to 19,200 bps are supported, all through keyboard commands.

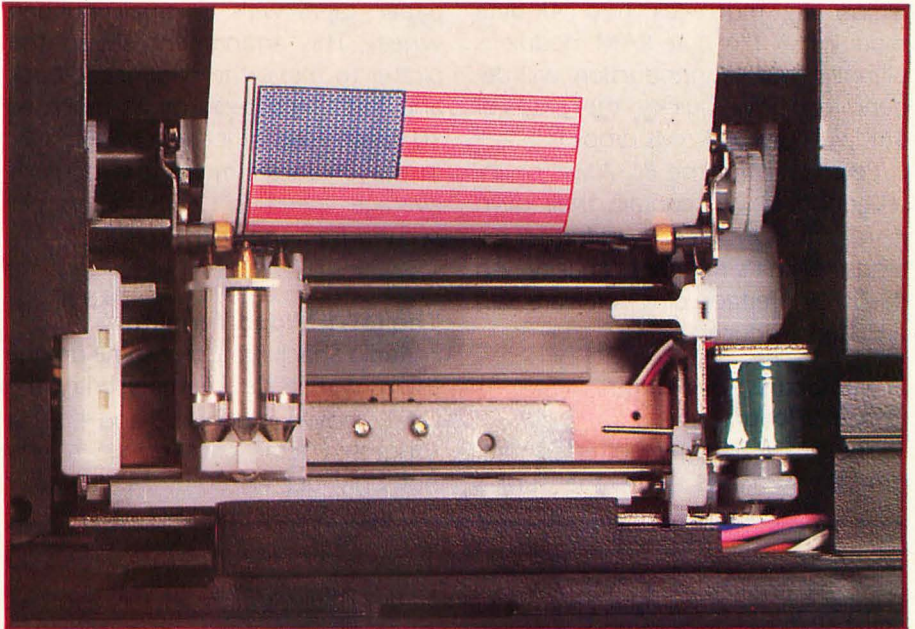


Photo 2: The PC-2 Pocket Computer from Radio Shack features an optional four-color PC-2 Printer/Plotter. The PC-2 contains 2.6K bytes of RAM and 16K bytes of ROM. Provision for a plug-in module allows an additional 16K bytes of RAM, ROM, or both. A 4K-byte RAM module is available for \$69.95. PC-2 peripherals are intelligent and contain additional RAM and ROM. The Printer/Plotter can produce nine sizes of characters and plot graphs and charts with a resolution of 0.2 millimeter.

Photo 4: The DT-1 video terminal achieves new heights in configurable systems. Not only does the DT-1 have built-in provisions for emulating four popular terminals, it can also be programmed from the keyboard to emulate most other terminals with similar capabilities. Emulation and transmission parameters are stored in an EEPROM, which means, in effect, that the DT-1 programs itself. Parameters can be changed on a more temporary basis as well, without being programmed into the EEPROM.





necter that brings address data, interrupts, timing, and control signals to the outside world.

The basic PC-2, which retails for \$279.95, contains 16K bytes of ROM (read-only memory) and 2.6K bytes of RAM. There is provision for one additional plug-in module which may be RAM, ROM, or a combination of both. A 4K-byte RAM module is available for \$69.95, and an 8K-byte RAM will be introduced in the near future. The 8K-byte RAM is expected to cost almost as much as two 4K-byte modules. A 16K-byte RAM module is planned, but its introduction will depend on how quickly the price of 16K-byte CMOS RAMs drops.

Peripherals for the PC-2 will be intelligent and will contain their own RAM and ROM which will further extend the unit's memory capacity. An RS-232C interface plus software will also be introduced.

#### A Miniature Four-Color Printer/Plotter

The PC-2 Printer/Plotter is impressive. Packed into the unit's

minuscule chassis is a four-color plotter that "draws" letter-quality characters in nine different sizes on standard 2½-inch adding-machine tape and creates four-color graphs and charts (see figures 1 and 2). A small circular barrel holds the four miniature solenoid-selectable pens.

The PC-2 Printer/Plotter is not a toy; it is capable of plotting with a resolution of 0.2 millimeter! It features a simple, yet sophisticated paper-drive system that anchors one side of the paper tape with a small nubbed wheel. This arrangement allows the plotter to move the paper tape back and forth repeatedly by as much as 10 centimeters as it creates an image. In the character mode, the printer's average speed is 12 characters per second (see photo 2).

#### The DT-1 Video Terminal

Radio Shack has done some unique things with its new terminal entry, the DT-1, shown in photos 3 and 4. For a suggested retail price of \$699, you not only get an 80-by-24 character

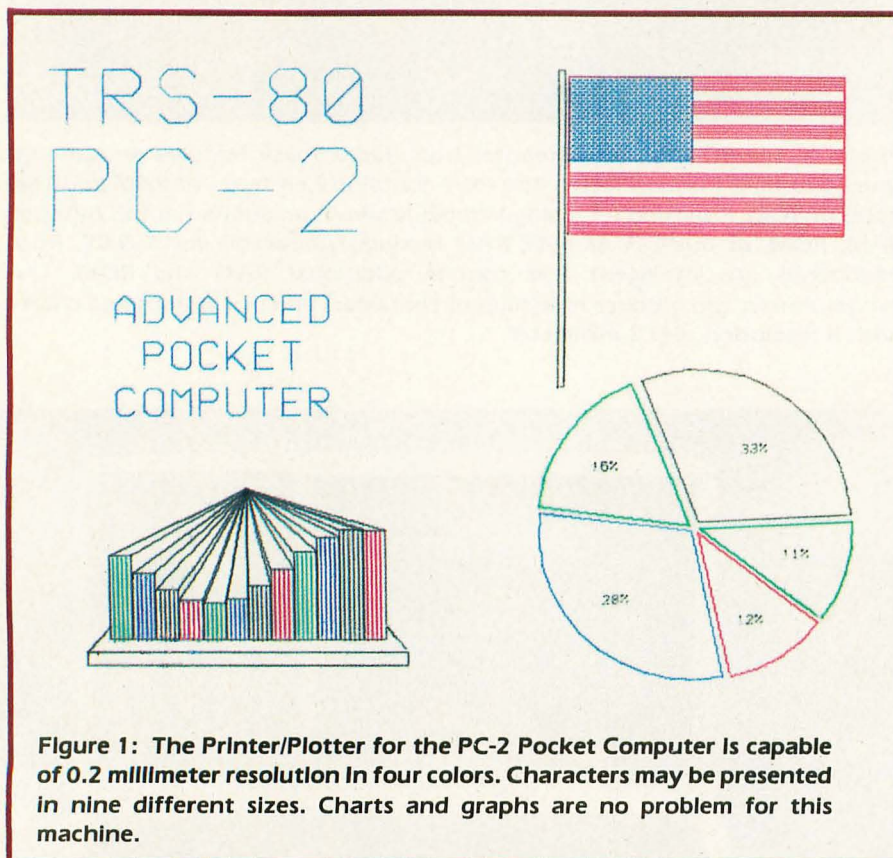
display, serial-communication port, and both serial- and parallel-printer ports—you also get the built-in capability of emulating a number of other terminals, including the Televideo 910, Lear Siegler ADM-5, ADDS 25, and Hazeltine 1410. This is accomplished by simple commands from the keyboard; no DIP switches to set. All emulation parameters as well as transmission protocols such as word length and data rate are then stored in an EEPROM (electrically erasable programmable read-only memory). Thus, the DT-1 actually reprograms itself. Even when power is turned off, the DT-1 retains its emulation and transmission parameters.

As if that weren't enough, you have the ability to change any or all of the emulation and transmission parameters, which allows you to emulate a number of other terminals in addition to those that are built in. The cursor is programmable from the keyboard and may be either a steady or blinking block or underline. The video attributes include normal, reverse, invisible, blink, underline, and half intensity. Data rates from 75 to 19,200 bps are available. The black-and-white monitor section of the DT-1 is identical to that of the Model II computer.

#### High-Resolution BASIC Graphics Package for the Model II

A \$499 high-resolution BASIC graphics package that allows the user to create black-and-white graphics with a resolution of 640 by 240 pixels is now available for the TRS-80 Model II (see photos 5 and 6). The price includes a plug-in printed-circuit board with 32K bytes of on-board memory. Because the high-resolution graphics are generated from a separate memory, both text and graphics can be overlaid on the screen and each can be cleared separately.

The accompanying BASIC package features the same commands as the high-resolution BASIC for the TRS-80 Color Computer, except that only black and white can be chosen. Radio





Shack is including a library of commands that allow you to pass parameters from COBOL, FORTRAN, or assembly-language programs—a nice touch.

Yet to come is a printer dump routine that lets the user dump the screen to the Radio Shack Lineprinter VIII. Note: In order to use the high-resolution BASIC graphics package, your Model II must have the latest CPU (central processor unit) board, because the original Model II CPU board has a different set of wait states than the graphics board requires.

Radio Shack will retrofit any Model II with the latest CPU board if you bring your computer to a Radio Shack computer center. The upgrade, if needed, is included in the cost of installing the graphics package.

### Final Thoughts

These four new products from Radio Shack indicate both a continuing commitment from the company to the furthering of the state of the art, and reaffirmation of the company's refreshing entrepreneurial approach to new computer products. ■

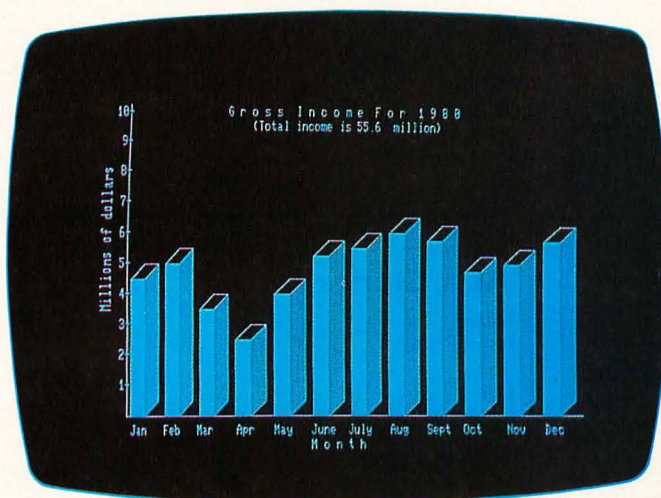


Photo 5: A bar graph produced with the Model II high-resolution graphics package. Both text and graphics can be mixed on the screen and selectively erased.

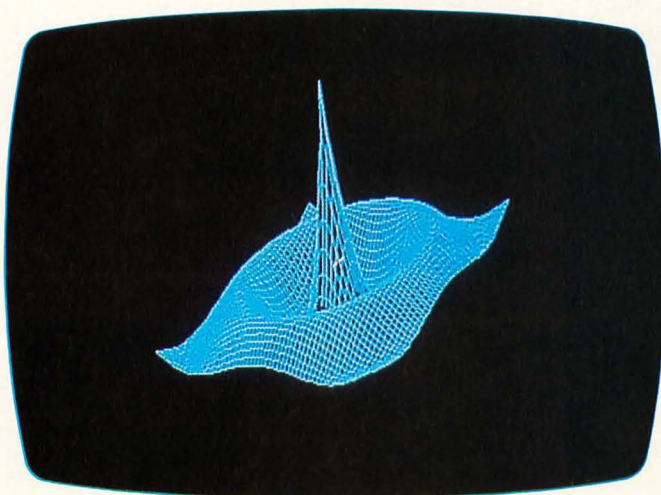
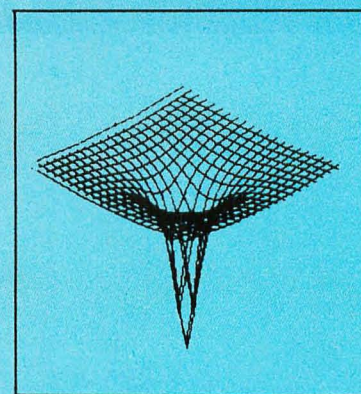


Photo 6: Another example of what is possible using the Model II high-resolution graphics package.



```

RANDOM : CLEAR
: DIM A$(1)*56:
DEGREE .WAIT 0
10:K=0:RESTORE 50
:FOR I1=1TO 10
:READ A$(1):
PRINT A$(1)
15:FOR J=1TO 60:A
$=INKEY$ :IF A
$<>"":LET J=60
20:NEXT J
22:IF A$="" THEN 3
5
25:FOR J=1TO 10:
IF MID$( "1234
ABCDEF", J, 1)=A
$LET K=J:J=12
30:NEXT J
31:IF KCLS :ON K
GOSUB 100,2000
,600,800,300,4
00,500,700,900
,1000:GOTO 5
35:NEXT I1:IF RND
(25)>2 THEN 10
40:K=RND (10):IF
K<>8 THEN 31
45:GOTO 10
50:DATA "1 - LCD
display & grap
hics", "2 - Fea
tures Banner",
"3 - Clock", "4
- Beeper"
55:DATA "A - 3-D
Bar Chart", "B
- Pie Chart",
C - 2-D User B

```

Figure 2: Mixing text and graphics is easy with Radio Shack's new Printer/Plotter. Also shown is a partial BASIC listing.



## Integral Data Systems' Prism Printer

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Ed Umlor  
E & G Umlor Enterprises  
4 South Street  
Milford, NH 03055

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Integral Data Systems (IDS) has introduced an innovative printer called the Prism, whose modular design uses add-on options which let you upgrade the machine as needed.

The basic 80-column Prism is available for \$899 and yields correspondence-quality print using an overlapping 24 by 9 dot matrix. Printing bidirectionally at 110 characters per second (cps) (up to 150 cps for proportionally spaced characters) the Prism printer is capable of 10, 12, or 16.8 character-per-inch densities, plus double-width characters.

Selectable standard features on the basic printer include automatic text justification, programmable horizontal and vertical tabbing, reverse paper feed, and "fine positioning" of characters to 1/120 inch. Up to four different 96-character sets can reside within the printer at the same time, although the basic unit is provided with only one 96-character set.

The Prism is microprocessor controlled, with true logic-seeking capability. It comes with a standard RS-232C serial interface as well as a Centronics-compatible parallel interface. Serial transmission rates from 110 to 9600 bits per second (bps) are switch selectable.

Six upgrade kits can be added to the printer at any time making it one of the faster printers in its price category. (As a comparison, an 80-cps printer drops to about 60 cps in enhanced mode and 40 cps in double-strike mode.) The Prism does not have a double-strike mode, although it is capable of providing it with the proper software. You can do reverse linefeeds.

### External Controls

A slot on the top left side of the printer exposes the self-test switch and the power-up configuration switches—a

### At a Glance

**Name**

Prism Printer

**Use**

Dot-matrix printer

**Manufacturer**

Integral Data Systems  
Milford, NH 03055  
(603) 673-9100

**Dimensions**

80-column: 9.1 by 15.75 by 12.4 inches (23.1 by 40 by 31.5 cm)  
132-column: 9.1 by 21.6 by 12.4 inches (23.1 by 54.9 by 31.5 cm)

**Features**

80 and 132-column models, 24 x 9 dot matrix, bidirectional printing at 110 to 150 cps, true logic seeking, automatic text justification, programmable horizontal and vertical tabbing, 96-character ASCII set, up to four character sets coresident, microprocessor controlled, RS-232C and Centronics-compatible interfaces.

**Options**

Cut Sheet Feeder, Dot Plot, Prism Color, Sprint Module, additional character sets, cassette for fully automatic sheet feed.

**Price**

80-column, basic unit, \$899; 132-column, basic unit, \$1299; Options available now; Cut Sheet Feeder, \$149; Dot Plot, \$99; Prism Color, \$399; Sprint Module, \$99. To come: Additional fonts, \$99; cassette for automatic sheet feed, \$399. **Note:** Until April 1, 1982 only—Special Option Package: Cut Sheet Feeder, Dot Plot, and Sprint Module, \$297.

**Warranty**

90-day limited



very nice touch in the design of the printer. Unlike most printers, you do not have to remove the cover or fumble with the unit to change the power-up parameters. Three switches located under this slot provide self-test on/off (a

## A Closer Look

The Prism printer gave me several pleasant surprises. The early IDS Paper Tigers were some of the loudest printers I had encountered. When IDS engineers designed the 560—and now the Prism—they acoustically insulated the case and lowered the noise level to less than 63 dBA, a level suitable for most office environments. (By the way, the case for the Prism is identical to the one used on the 560.)

The print quality in the normal mode is excellent. Most other printers require an enhanced mode (move over ½ dot and strike again) or double-strike mode (reprint entire line) to achieve the same character quality. Furthermore, the Prism produces this type at 110 to 150 cps, and may be used in any combination. Cut Sheet Feeder, Dot Plot graphics, Prism Color, and Sprint Module upgrades are available now; special character sets and a cassette for fully automatic sheet feed will be available in the near future.

Control Line Form Length			
S3-1	S3-2	S3-2	Length (inches)
Off	Off	Off	3
Off	Off	On	4
Off	On	Off	3.5
Off	On	On	7
On	Off	Off	12
On	Off	On	11
On	On	Off	8.5
On	On	On	14
Control Line Serial Data Rate			
S3-4	S3-5		bits per second
Off	Off		2400
Off	On		300
On	Off		9600
On	On		1200
Selecting Parity			
S3-6	S3-7	Parity	
Off	Off	No parity, transmit space	
Off	On	No parity, transmit mark	
On	Off	Even parity	
On	On	Odd parity	

**Table 1:** DIP switch 3, located on the top left-hand side of the printer and accessible through a slot located there, controls form length, data rate for the RS-232C interface, and the parity. Although the switch sets the default values upon power-up, they can be overridden by software commands.

toggle switch), print-parameter controls (DIP switch S4), and form-length and serial-interface-parameter controls (DIP switch S3). The self-test switch is nonactive with the lever to the left and active (only in the off-line mode) when the lever is to the right. S4-1 and S4-2 set the character density and characters per inch (cpi), OFF-OFF sets the 5-cpi mode (double-width mode), OFF-ON sets the 16.8-cpi mode (condensed mode on most other printers). S4-3 selects 6 lpi (lines per inch) when OFF or 8 lpi when ON. S4-4 controls the automatic boundary skip (so the printer skips over the perforations on fan-fold paper) of one inch. When OFF, S4-4 disables the skip; when S4-4 is ON the skip is enabled. S4-5 is the switch TRS-80 users will be interested in. ON enables the auto linefeed on carriage return and OFF disables the auto linefeed. S4-6 controls the default setting of the Sprint Mode and is not used in the basic Prism. S4-7 controls the expanded functions (IDS's name for software control). Once again, ON enables and OFF disables software control. The functions of DIP switch 3 are shown in table 1.

On the right side of the top of the printer are two switches and a marker plate with several indicator lights. The left switch is a three-position switch labeled FS/OFL/ONL (Forms Set/Off line/On Line). The right switch is a spring-loaded, center return (off position), two-position switch labeled FF/LF (Form Feed/Line Feed). The indicators are for fault, on line, and power on.

## Software Control

Many software commands are available with the basic unit. Here is a complete rundown. A line feed, Ctrl-J or CHR\$(10), causes the paper/form to advance one line vertically. A form feed, Ctrl-L or CHR\$(12), feeds the paper/form vertically to the next top of form. A carriage return, Ctrl-M or CHR\$(13), causes the carriage to return without a linefeed (unless S4-5 is set to auto linefeed) after printing data in the buffer. These three controls will operate regardless of S4-7's position.

Now let's take the rest by the numbers:

- Ctrl-A or CHR\$(1): set expanded mode (double wide).
- Ctrl-B or CHR\$(2): reset expanded mode.
- Ctrl-D or CHR\$(4): set justify mode on (left and right margins are even).
- Ctrl-E or CHR\$(5): reset justify mode.
- Ctrl-F or CHR\$(6): set printer to fixed character space.
- Ctrl-I or CHR\$(9): tab to next set horizontal tab.
- Ctrl-K or CHR\$(11): tab to next set vertical tab.
- Ctrl-N or CHR\$(14): do two line feeds (double space vertical).
- Ctrl-P or CHR\$(16): print characters proportionally spaced.
- Ctrl-Q or CHR\$(17): reset the deselect mode.
- Ctrl-R or CHR\$(18): line feed without carriage return (S4-5's position makes no difference).



Ctrl-S or CHR\$(19): deselect printer (causes it to ignore data from computer).

Ctrl-T or CHR\$(20): do two line feeds without carriage return.

Ctrl-Y or CHR\$(25): do three line feeds without carriage return.

Ctrl-Left bracket or CHR\$(27): cause the printer to enter/exit the programming mode (This is called the escape code ESC).

Ctrl-Right bracket or CHR\$(29): set printer to 10 cpi.

Ctrl-Uparrow or CHR\$(30): set printer to 12 cpi.

Ctrl-Underscore or CHR\$(31): set printer to 16.8 cpi.

ESC F or CHR\$(27)+"F": program horizontal tabs in increments of 1/120 inch (1 inch = 120, 2 inches = 240, . . . etc). CHR\$(27); "F,120,240,600,\$" will set tabs at 1 inch, 2 inch, 5 inch points. You can set up to 8 tab points.

ESC B or CHR\$(27)+"B": set vertical tab 1 in increments of 1/48 inch. CHR\$(27); "B,24" will set a 1/2-inch vertical tab with only one point allowed. This is ADV-1 and defaults to 8 or 6 as S4-3 is positioned.

ESC C or CHR\$(27)+"C": same as ESC B but with a default value of 8, which is a 6-lpi subscript value.

ESC D or CHR\$(27)+"D": same as ESC B but with a default value of -8, which is a 6-lpi superscript value.

ESC E or CHR\$(27)+"E": same as ESC F but for vertical tabs (1/48-inch increments) and up to 8 values can be set.

ESC G or CHR\$(27)+"G": set the absolute head position from the home position in 1/120-inch increments.

ESC H or CHR\$(27)+"H": set absolute head position from top of form.

ESC J or CHR\$(27)+"J": set margins—two values are required, left margin first, then the right margin (1/120 inch).

ESC L or CHR\$(27)+"L": set vertical form length—two values are required, form length first and then the printable space within that length. This instruction works within the form-length switch settings (1/48 inch).

ESC P or CHR\$(27)+"P": sets the intercharacter spacing in increments of 1/24 character width.

In all the above instructions, a "\$" is required as the last character to terminate the instruction. Tabs may be cleared by setting a single tab to 0: CHR\$(27); "E,0,\$" clears the vertical tabs and CHR\$(27); "F,0,\$" clears the horizontal tabs. (I have deliberately not put the PRINT statement in these examples due to the variety of forms it can take. With the Apple computer you open the printer port and then use PRINT statements. With the TRS-80 you have to use LPRINT statements.)

## Options

The \$149 Cut-Sheet option (what I call letterhead) adds friction feed to the Prism printer. Most printers that have a friction option force you to feed the paper from the top and manually advance it to the position where you want

Fig. 1A

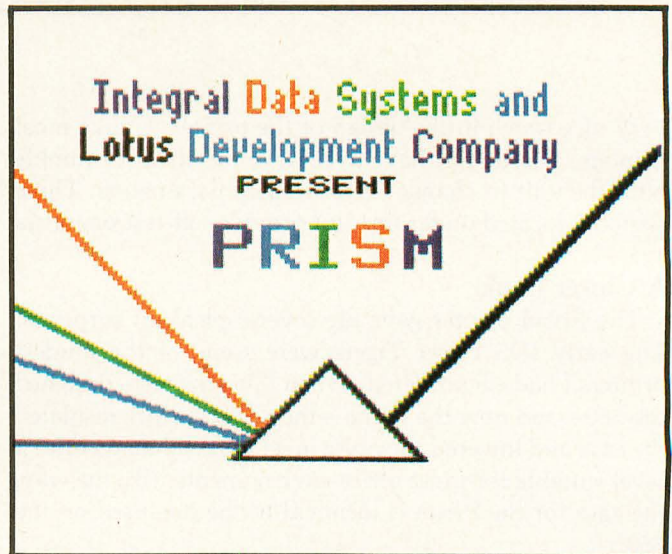


Fig. 1B

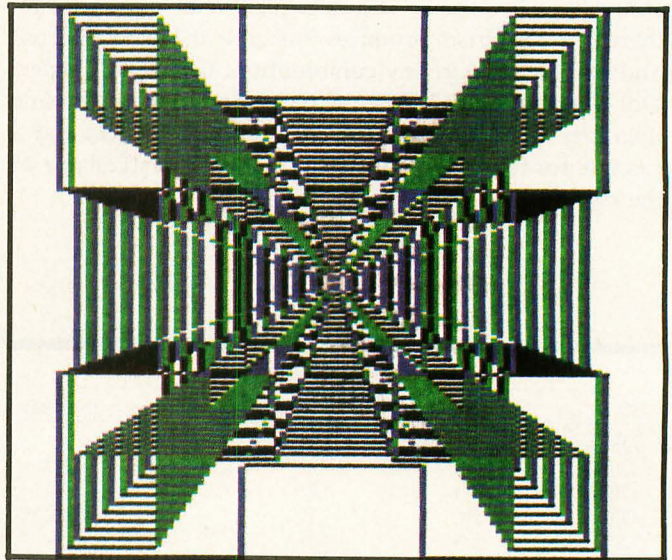
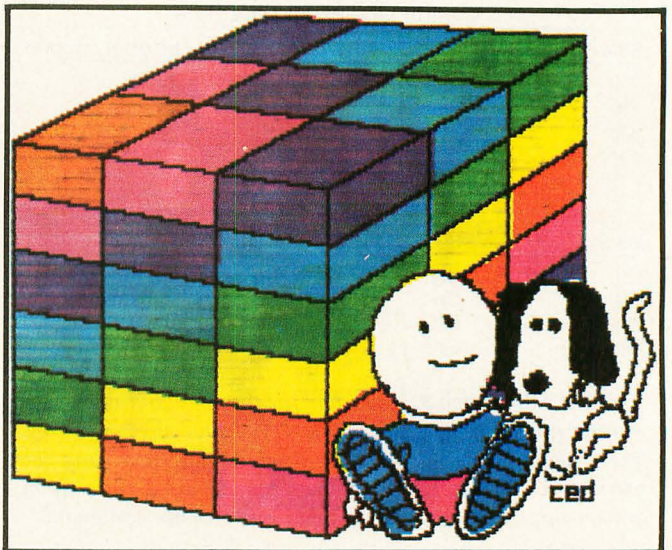


Fig. 1C





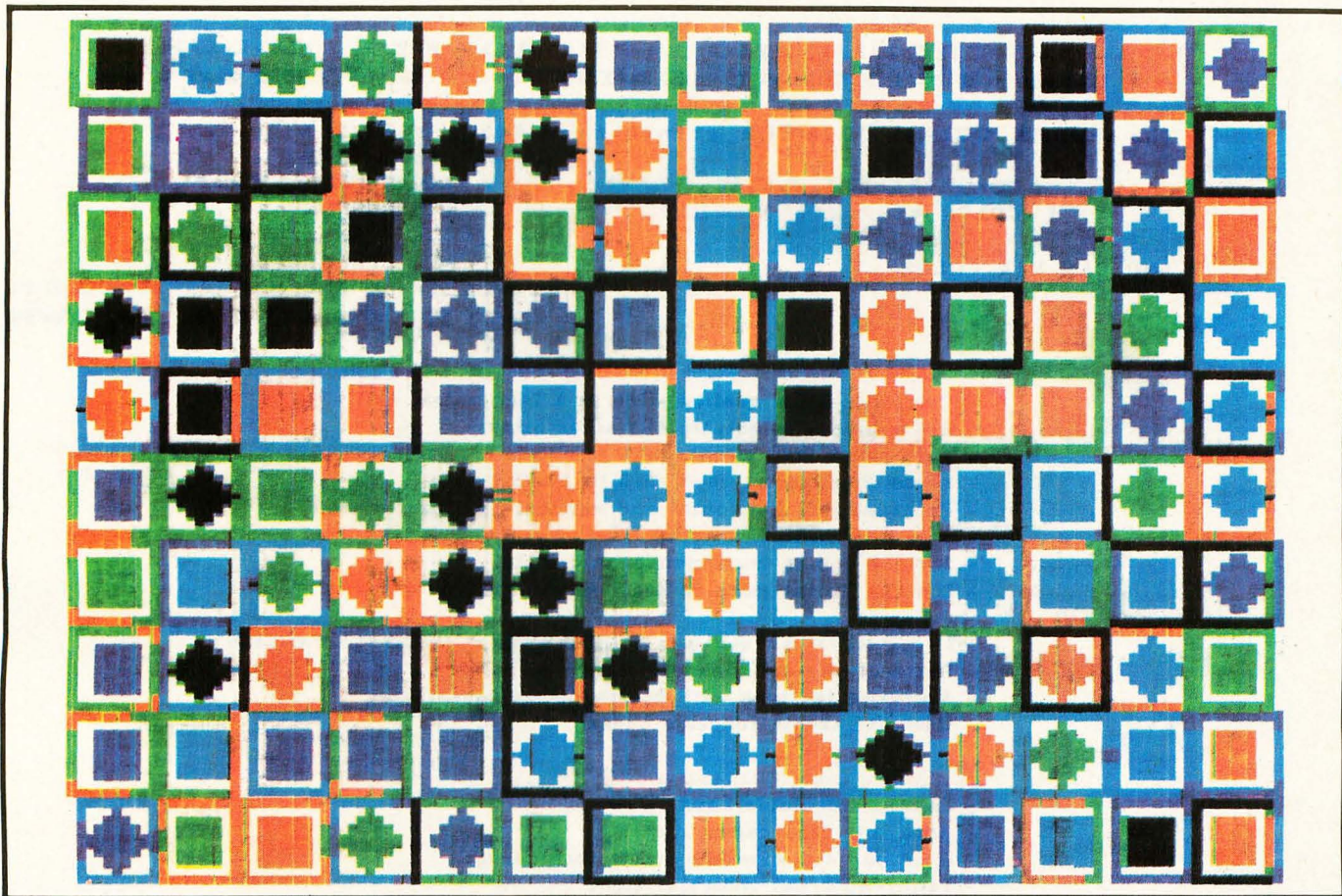


Figure 1: Four examples of color graphics. These were produced on a 132-column Prism printer with the Dot Plot and Prism Color options and the process-color ribbon. Graphics are dot addressable.

to start printing. If you are good at it, you won't have to square up your sheet. It is also very difficult trying to print to the bottom of the page with other friction-feed printers. The Prism's Cut Sheet option shows the same care in design as the rest of the unit. You can feed the paper from either the back or front of the printer. A photo sensor detects the paper being inserted. After a one-half- to one-second delay, the pinch rollers start to revolve, and if you have inserted the paper correctly it will feed and position the sheet to the first printable line on the paper. You might have to manually line feed past your letterhead, or you can handle that with your word-processing software. You will have to adjust the tractors on the printer to allow the paper to feed through them with the pins just to the outside of the paper. IDS has placed a set of pinch rollers into the tractors that are driven by the normal tractor-feed mechanism and continue to feed the paper after the bottom pinch rollers have been passed. With the out-of-paper sensor located at the print head level, this allows the printer to print clearly and evenly right to the last line on the page. A simple form feed will eject the letter completely from the printer. Very nice indeed for the office that does a lot of letters on standard letterhead bond.

Dot Plot is a \$99 dot-addressable graphics option package. The density is 84 by 84 dots per inch (dpi) for single-pass raster and 168 by 168 dpi for a four-pass raster. This option adds more control codes for you to play with. To enter the graphics mode you set switch S4-5 to ON and send a Ctrl-C (CHR\$(3)). You can also select unidirectional (default) or bidirectional graphics by sending Ctrl-L or Ctrl-V, respectively. To exit you use a Ctrl-C + Ctrl-B (CHR\$(3);CHR\$(2);). In the graphics mode you have to be careful to always end your BASIC instruction line with a semicolon to prevent the automatic generation of carriage returns and linefeeds, as these would be printed as graphic characters and mess up your picture. Seven wires of the print head are used in the graphics mode and are bit controlled. Bit 0 controls the top wire and bit 6 controls the bottom wire. Bit 7 is ignored. You also have vertical and horizontal control if you use the previously given codes prefixed by CHR\$(3).

Prism Color is a \$399 color-capability option that adds color designator control codes to your instruction set. The printer that I reviewed did not have this option, so my assumptions are based on the color ribbons that I saw. You will have a choice of three ribbons: black plus process colors for mixing, black plus primary colors, and



## INTRODUCING AFFORDABLE COLOR The INTEGRAL DATA PRISM™ Printer

The PRISM COLOR PRINTER prints four basic colors :

COLOR #4=BLACK  
COLOR #2=MAGENTA

COLOR #3=CYAN  
COLOR #1=YELLOW

AND CAN MIX COLORS :

MIX #1+#2, ORANGE  
MIX #2+#3, VIOLET

MIX #1+#3, GREEN  
MIX #2+#4, BROWN

### Versatile Printing Capabilities

- Correspondence quality print in a 24x9 matrix cell
- Six software selectable character sizes
- Auto sheet feed mechanism
- Adjustable tractor feed, 5.0 to 14.75 inches
- Programmable horizontal and vertical tabbing
- 6 or 8 lines/inch spacing
- 110-150 cps in correspondence quality
- 200 cps Sprint Mode in draft matrix quality

### Microprocessor Driven Controller

- State-of-the-art technology
- Versatile features with programmable capabilities
- User defineable function codes

### Ease of Operation

- Switch selectable baud rates
- Auto line feed capability
- Hardware/software selectable forms length
- Fault/Paper-out indicator light

### Ready Serviceability

- Simple mechanisms for easy service
- Modular design provides for low MTTR
- Built-in diagnostics and Self-test mode

### Interfaces for All Configurations

- Parallel (Centronics compatible)
- RS-232c (up to 9600 bd) with Xon/Xoff protocol
- 115/230 volts, 50/60 Hz power, switch selectable

### DotPlot Graphics Capability

- High resolution raster graphics
- 84x84 dots/inch
- Includes 1500 byte character buffer
- Long-life cartridge ribbon system



## INTEGRAL DATA SYSTEMS

Milford, N.H. 03055  
(603) 673-9100

Figure 2: Combining color with text. Color adds a new dimension to reports, manuscripts, and other documents. Combined with Dot Plot graphics, the possibilities are endless.







## Use Voiceprints to Analyze Speech

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Glastonbury, CT 06033

Do you ever talk to your computer? I do. But it doesn't understand a word I say. That's just as well right now, because I talk to it mostly in moments of hardware-induced frustration.

Of course, the computer talks to me. If you've read my June and September 1981 Circuit Cellar articles, you know that my computers can talk using two different methods of voice synthesis. At present, a computer can synthesize speech much more easily than it can recognize speech.

Professional speech-recognition systems currently on the market can cost up to \$100,000. Budget-priced systems for personal computers are available for about \$500, but of course, they don't perform as well.

My mail has been full of requests from readers for a speech-recognition circuit. Most correspondents point out that such a project is a natural follow-up to the two articles on voice synthesis. Unfortunately, designing a cost-effective voice-input speech-rec-

ognition system is a major project; it not only requires a complete understanding of the techniques involved but also necessitates skills in the design of filter networks and intricate data-comparison algorithms.

The basic concept of speech recognition is rather simple: have a computer digitize the analog voice waveform of each spoken word and compare it to a stored reference vocabulary. A basic block diagram is shown in figure 1.

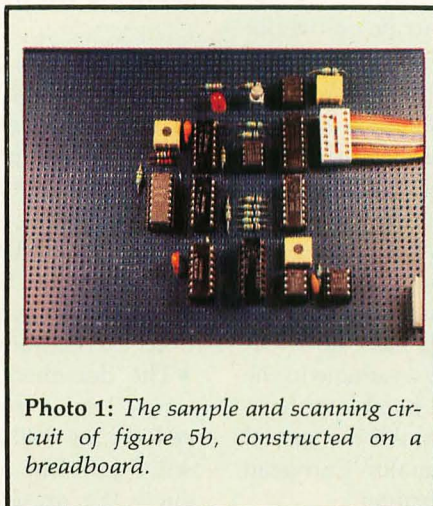


Photo 1: The sample and scanning circuit of figure 5b, constructed on a breadboard.

First, the analog voice input is amplified, then it is digitized to form a *word template*. This template formatting can be done by various techniques that include bandpass filters, A/D (analog-to-digital) converters, zero-crossing detectors, or fast Fourier analyzers. The result, whatever the technique, is a digital representation of the word spoken into the microphone. In an inexpensive speech-recognition system, this word template might be 10 bytes long, whereas in a \$100,000 system the template may have 10K bytes of data per word.

The input word template is then processed by a computer and compared to a series of templates stored in memory. The stored templates constitute the machine's vocabulary. A spoken word is deemed to be recognized when there is an exact or reasonably close match with one of the stored templates.

In practical speech-recognition systems, the size of the word template must be traded off against the amount of available memory or storage and the computing power of the processor. With a small template, the



words are not very well defined, and there is a considerable possibility that the computer will confuse two different words. On the other hand, large templates, which more precisely define the words, take considerably more time for comparison as well as more storage space.

To achieve reasonably fast recognition with large templates, the computer must digest information at prodigious speed. In professional speech-recognition systems, a typical processor might perform 1 million 16-bit by 16-bit multiplications per second. Creating such a number cruncher is expensive.

To build a speech-recognition system on a low budget, using a microprocessor, we must make some compromise either in the time allotted for the computer to recognize a word or in the precision with which words are defined in the templates. There must be some amount of storage between 10K and 10 bytes that defines a word sufficiently well for our low-cost speech-recognition system to recognize it within a tolerable duration.

### Preliminary Research

This article doesn't tell you how to build a speech-recognition system.

We aren't ready for that yet. Instead, it describes a scheme to analyze the audible content of speech so that we can more accurately define a suitable template size.

A definition of just how much data is required can be determined only by carefully examining the spectral content of speech and analyzing the differences between the words we want to have the computer recognize. Just what is the audible difference between the numbers "six" and "eight"? Is there a unique set of data points that allows them to be easily differentiated?

In essence, the information we are looking for is a kind of fingerprint for speech, a *voiceprint*. (It may also be called a *spectrogram*.) By visually comparing the spectral voiceprints of words, we can perhaps come to understand details of definitive templates and the workings of comparison algorithms.

We may find that in a limited-vocabulary speech-recognition system the spectral differences between the words in the selected recognizable set may be so distinct that the template resolution can be reduced to perhaps less than 100 bytes. It is also possible that such an examination will demonstrate that a monumental effort must be exerted to distinguish between two words such as "seem" and "seen."

I hope to eventually write about a voice-response speech-recognition system. Such a project seems to lie

within the scope of a Circuit Cellar article. For the present, however, I am still researching certain information about the significant differences between words, seeking to answer such questions as: Must data on amplitude as well as frequency be recorded? Must the input word be digitized in real time? Can the stored template data be compressed in some way? What frequencies are important and which can be ignored? Is there much variation between different utterances of the same word?

This month's hardware project, a spectral voiceprint display, should help answer some of these questions.

### What Are Voiceprints?

When you speak, the sound that comes out of your mouth is composed of various frequencies blended together to create the tonal quality that is unique to your voice. If you attach a microphone to the input of an oscilloscope and speak into it, you can watch the frequency and amplitude changes. The bandwidth of meaningful sounds for most voices is about 4 kHz. (Not coincidentally, this is the passband of a voice-grade telephone line.)

Another method of looking at the various frequencies present in voices is to produce a graph of speech waveforms showing frequency as a function of time. An example of this is shown in figure 2 on page 52. As the word "eight" is spoken, the majority of the energy is between 1 and 4 kHz

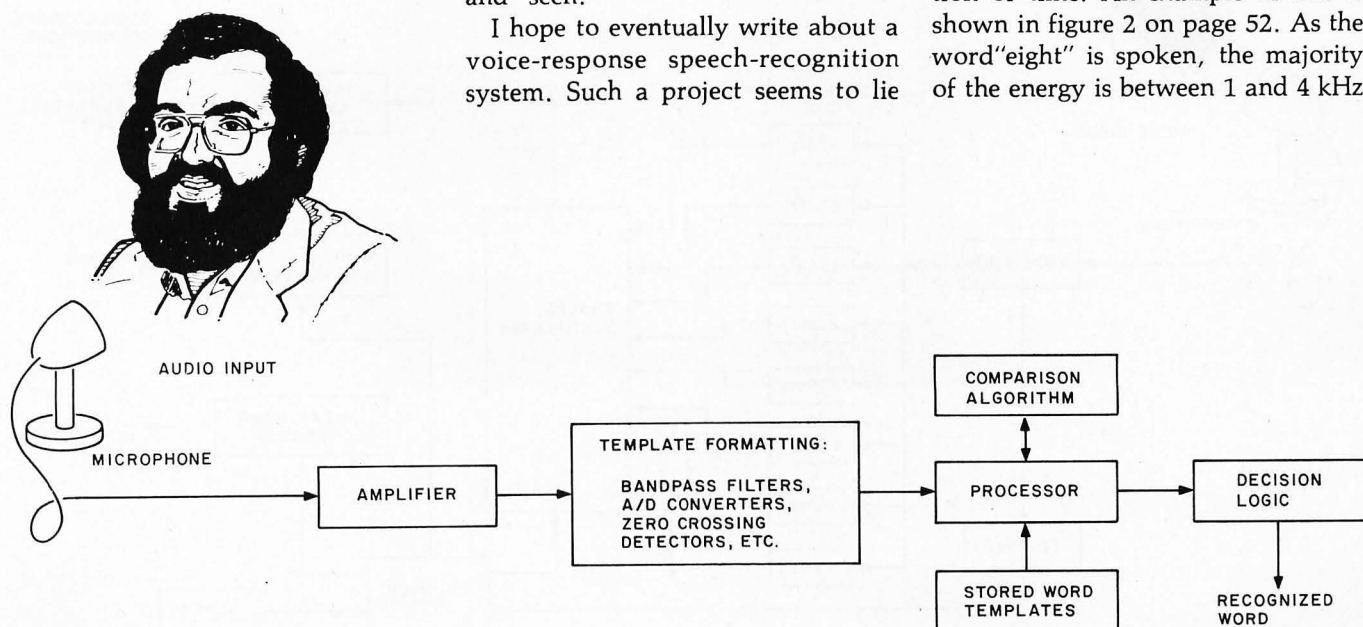


Figure 1: Block diagram of a computer speech-recognition system using word templates.



for the first 0.15 seconds, then a silent period is interrupted after another 0.15 seconds by a quick burst of energy at about 4 kHz. The first waveform group is the "eigh", and the final burst is the "t". A plot of the amplitude also provides significant information.

This sort of voiceprint or spectrogram shows a record of frequency and amplitude versus time.

Producing the graph shown in figure 2 requires an  $x,y$  plotter and a real-time spectrum analyzer. This equipment is costly and not generally available to the average experimenter, but with a little ingenuity we can obtain similar results with some simple bandpass filters and an oscilloscope.

### Economy Voiceprint Display

The laboratory spectrum analyzer typically used to produce voiceprints often contains either a scanning filter or FFT (fast-Fourier-transform) processor. Such equipment has extremely high resolution (as well as cost) and allows the operator to resolve frequencies separated by only a few hertz (Hz). This is much more resolution than is required for our applica-

tion, and a more cost-effective real-time spectrum analyzer can be substituted.

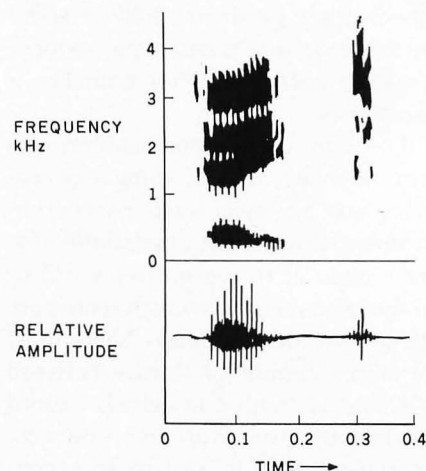
Figure 3 is a block diagram of the hardware I used to record voiceprints. It consists of an eight-octave bandpass filter connected to a microphone and some timing circuitry. The outputs of the circuit are connected to the  $x$ -axis,  $y$ -axis, and blanking ( $z$ -axis) inputs of an oscilloscope. The result is a three-dimensional view of the spoken word. The  $x$  axis represents time, the  $y$  axis represents frequency, and the  $z$  axis (brightness) represents amplitude.

The plot thus produced looks somewhat different from the spectrogram in figure 2, but it is equally representative of spectral content. The eight filter sections cover eight octaves from 31 Hz to 4 kHz. Concentrations of energy in the eight octaves appear as eight bands across the display.

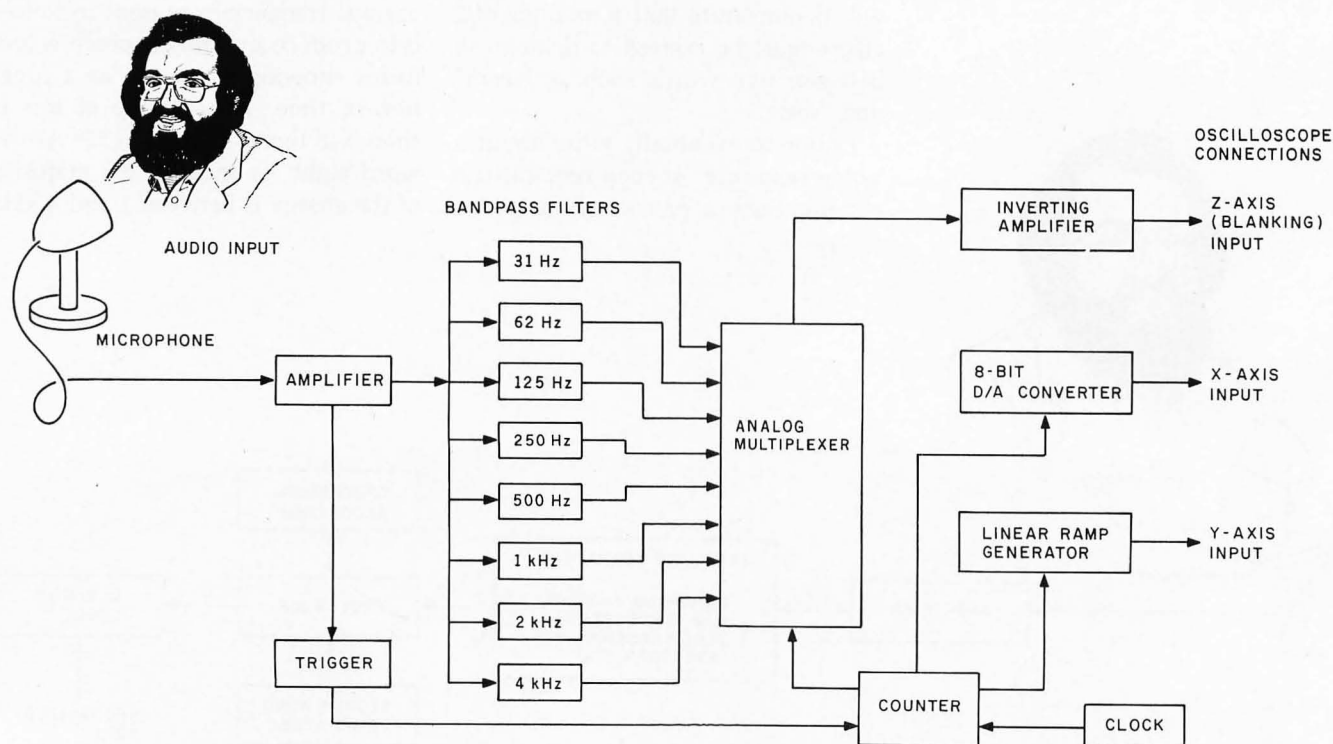
For example, if there are any frequencies present around 1 kHz, the 1-kHz band on the display is illuminated, appearing as a stripe across the oscilloscope screen. The amplitude of these frequencies governs the intensity of the stripe. If

this approximately 1-kHz signal is weak, the pattern will be dim; if it is strong, the pattern will be bright.

Figure 4 is an example of the kind of display produced by my interface circuit. This is approximately how the word "eight" appears when spoken. You'll note the grouping of energies corresponding to "eigh" and "t" as before. (There is also a shift in frequencies due to the fact that this display was produced by a different



**Figure 2:** A conventional voiceprint, or spectrogram, of a man saying the word "eight." Frequency is plotted as a function of time.



**Figure 3:** Block diagram of the Circuit Cellular voiceprint-recording system.



person speaking.) While unlike the ink-drawn spectrogram, it is equally detailed and unique.

On an 8- by 10-cm (centimeter) oscilloscope display, each frequency band occupies 1 cm on the vertical (y) axis. Time is recorded on the horizontal (x) axis where 1 cm corresponds to 0.05 seconds (all screen photos accompanying this article have these values). A complete word sample therefore represents sounds occurring during a one-half-second interval, consisting of 128 samples at each frequency. Changing the clock rate of the circuit can increase or decrease the scan time.

The scans appear as vertical lines on the screen. A full half-second sample consists of 128 vertical filter scans. Each vertical scan is divided evenly into eight sections corresponding to the eight filters. The bottom is 31 Hz, and the top is 4 kHz. The intensity of each segment of the scan line is determined by the output voltage of the particular filter: the more positive the output, the brighter the segment. If there is no output from a filter section during a segment interval, that portion of the segment will not be illuminated (it will be blanked). As configured, a half-second sample period scans the filters every 3.9 ms (milliseconds).

### How the Display Circuit Works

Figure 5 is a schematic diagram of the voiceprint-display system. It is basically divided into two sections: amplifier and filters (figure 5a on page 56) and the sample and scanning logic (figure 5b on page 58). A prototype of the sample and scanning logic is shown in photo 1 on page 50. The ribbon cable leads off to the amplifier and filter board.

Integrated circuit IC1 is a two-stage microphone preamplifier (you could substitute a much simpler circuit; this just happens to be the one I used) feeding output into IC2b, which has a sensitivity adjustment potentiometer and an additional stage of amplification. IC2a is an average level indicator. While each filter responds only to its preset frequency passband, this portion of the circuit passes all

frequencies and produces a DC voltage output proportional to the average volume level. This output is fed to the voltage comparator IC9, which switches when the average input level is above a certain amplitude, thus triggering the sample period when pronunciation of the word begins.

Integrated circuits IC3 through IC6 are configured as eight separate band-pass amplifiers with center frequencies at 31 Hz, 62 Hz, 125 Hz, 250 Hz, 500 Hz, 1 kHz, 2 kHz, and 4 kHz. The filters are not particularly sharp, possessing a frequency rolloff of about 8 dB (decibels) per octave. The output stage of each filter contains an integrator that converts the pass frequencies into an average DC level.

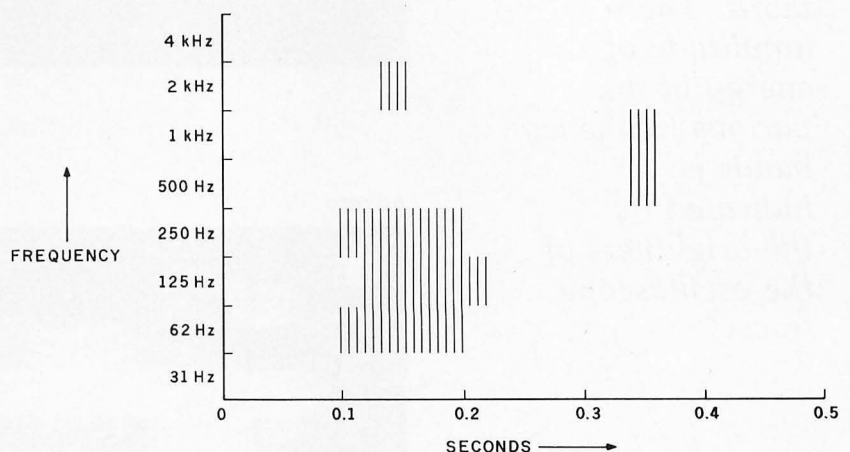
The timing network appears more complicated than it is. For a half-second word sample the clock rate is set for 4096 Hz and is divided down through an 11-bit counter configured from IC14 and IC15. The reset lines of the counters are controlled by the trigger-level comparator IC9 and an RS (set-reset) flip-flop formed from IC7, sections c and d. When the circuit triggers, the reset line on the counters is raised to a logic 1, and they begin to count. After 2048 clock cycles, the flip-flop is reset and the scanning is stopped. A timing

diagram is shown in figure 6 on page 60.

The 3 least significant bits of the counter control the address lines of an 8-channel analog multiplexer, IC16. The eight inputs of the multiplexer are the eight outputs from the filters, and the output of the multiplexer goes to the oscilloscope. When the multiplexer address is binary 000, the 31-Hz filter output is channeled through it to the scope blanking input, where it controls the oscilloscope-beam intensity. Similarly, binary 111 addresses the 4-kHz filter. (While this eight-cycle scan occurs every eight clock periods, it is displayed only at alternating scans.) The other 8 bits of the 11-bit counter set the 256 positions of the x axis (128 displayed and 128 blanked positions).

(The output level of the multiplexer should be set for the blanking range of your particular oscilloscope. This can be either a positive or negative voltage. My oscilloscope, a Tektronix model 2215, requires a negative blanking voltage, so I added IC10 as an inverting amplifier.)

Since an oscilloscope is an analog device, the digital counter outputs must be converted to analog voltages. Two different methods are employed in this circuit. The 8 most significant bits of the 11-bit counter drive an



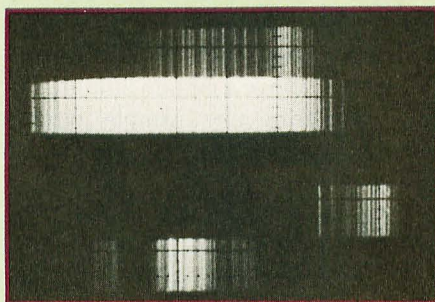
**Figure 4:** Typical display produced by the Circuit Cellar voiceprint system, of the word "eight." Although dissimilar in appearance to the conventionally plotted spectrogram of figure 2, it contains the same kind of information, along with indications of amplitude through modulation of the intensity of the scanning beam.



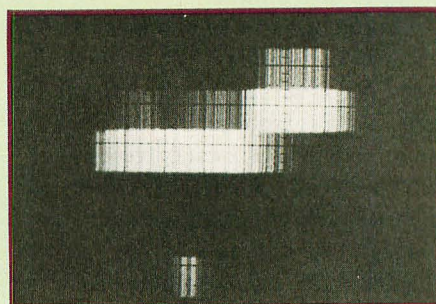
**Photo 2:**

*Voiceprints, or spectrograms, of various words being pronounced by a Micromouth voice synthesizer, as recorded by the circuit of figures 5a and 5b attached to a Tektronix model 2215 oscilloscope. Eight frequency bands are defined in the vertical y axis, while the horizontal x axis gauges time elapsed during the sounding of the word. The amplitude of energy in the various frequency bands is indicated by the brightness of the oscilloscope trace.*

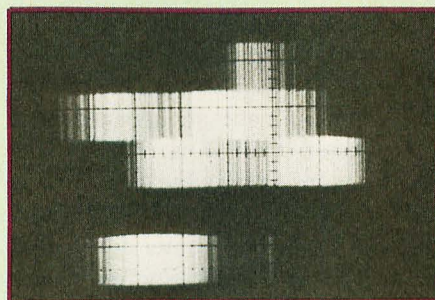
a. on



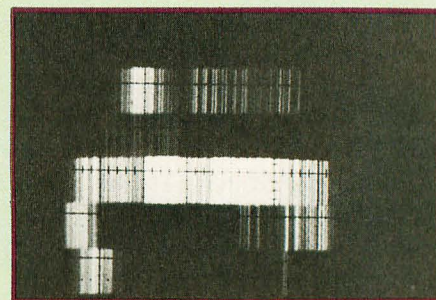
b. off



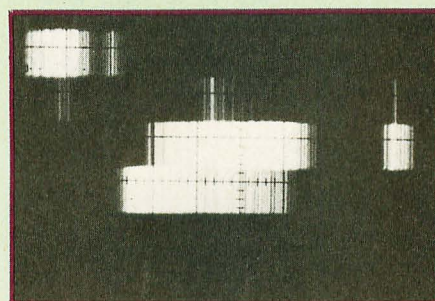
c. error



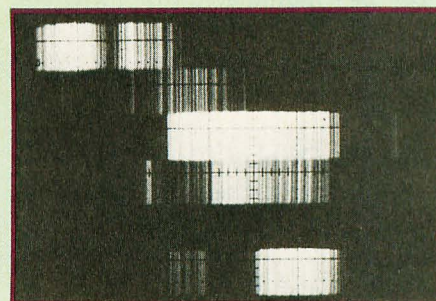
d. ready



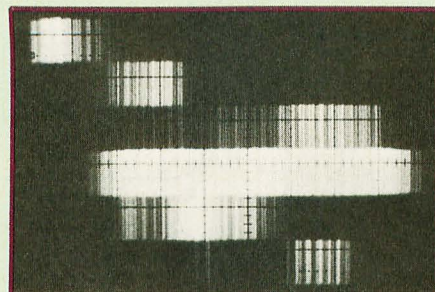
e. stop



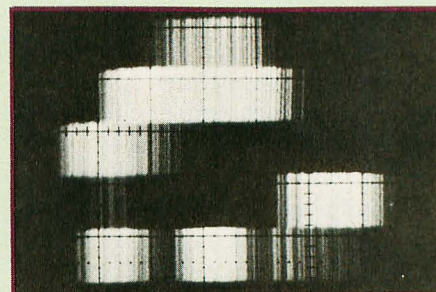
f. start



g. zero

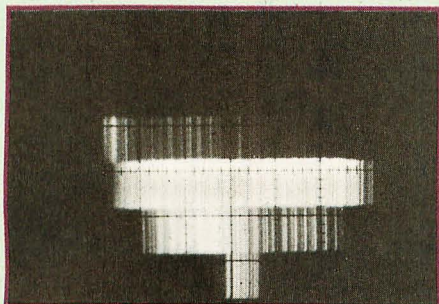


h. one

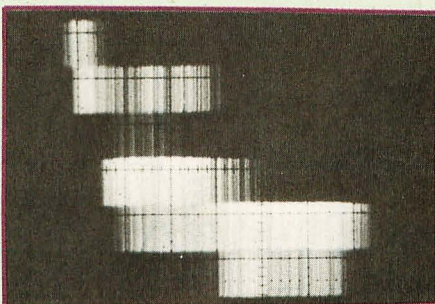




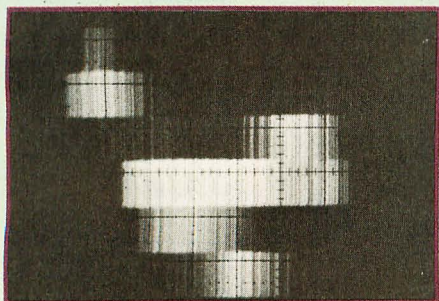
i. two



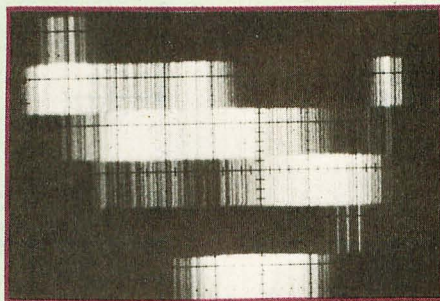
j. three



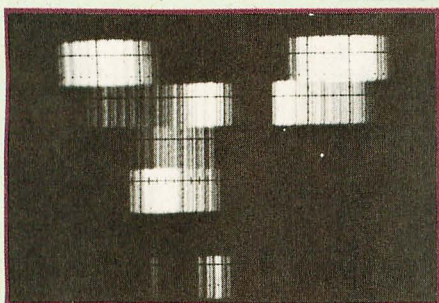
k. four



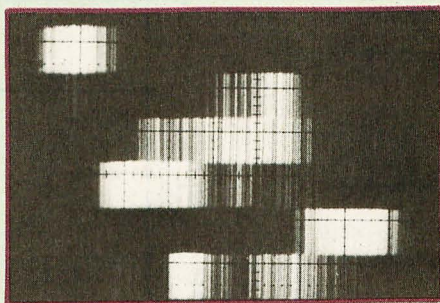
l. five



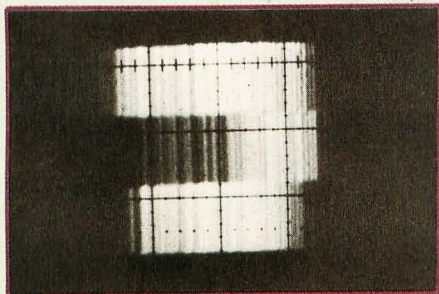
m. six



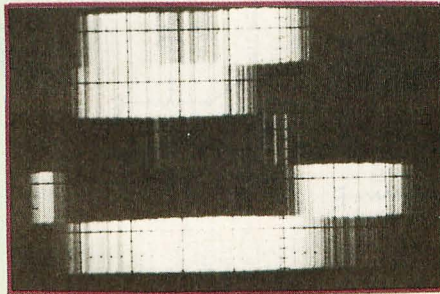
n. seven



o. eight



p. nine



R-2R-ladder D/A (digital-to-analog) converter, which I discussed in my January Circuit Cellar article. With a count of 0, the output is 0 V (volts); with a count of 255, the output is +5 V. Therefore, each step is 19.5 mV (millivolts).

With a clock rate of 4096 Hz, the D/A converter increases its output voltage by an increment of 19.5 mV every 2 ms. With the scope set for *x,y*-vector display mode, the *x*-axis scope trace proceeds from the bottom left corner (0 V) to the bottom right corner (+5 V), taking half a second.

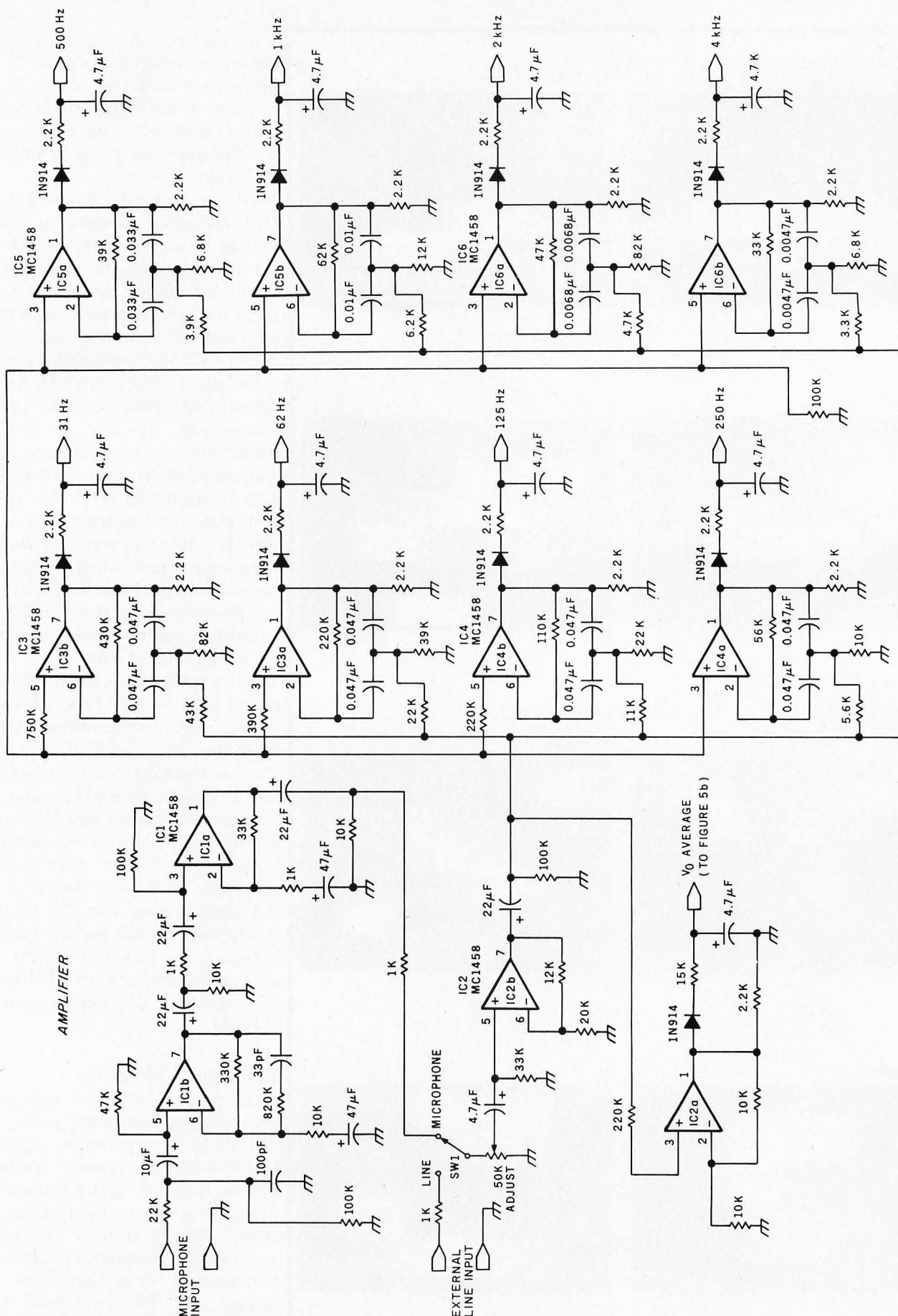
Initially I used a 3-bit D/A converter to increment the position of the *y*-axis beam. However, the 60-MHz bandwidth of the Tektronix scope was sufficient to cause each vertical scan to appear as eight dots rather than eight line segments. The scope was too fast. This was remedied by using a ramp-function generator configured from IC11 and IC17. IC11 is a positive-going integrator, and IC17 is a shorting switch connected across the integrating capacitor.

When the switch is closed, the output of IC11 is 0 V. This is the case during the odd-numbered scans, when the Q4 output of IC14 is high. On even scans the switch is open, and the capacitor is allowed to charge. As configured it charges linearly at a rate determined by the slope-adjustment potentiometer. This potentiometer should be set so that the output of IC11 (pin 6) goes from 0 V to 12 V during the 2-ms half period of the Q4 output. The clock rate affects this time period, so the slope will have to be readjusted if the clock frequency is changed.

### Recording Voiceprints

After connecting the voiceprint-generating system to the scope, you can begin to experiment. Speak a word into the microphone. The beam will be triggered, and the trace will move from left to right across the screen. Slowly increase the input-sensitivity potentiometer until the background noise saturates the display. All filters will have some output, and the screen will be completely unblanked. Slowly back off





**Figure 5a:** Section of the schematic diagram of the spectral voiceprint circuit, showing the amplifier and bandpass-filter components. Eight passbands are selected by the filter stages, with the output sent to the scanning and display section of figure 5b.



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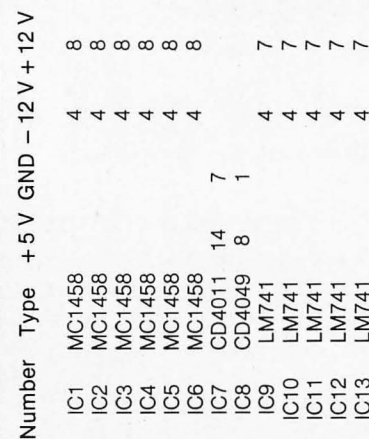
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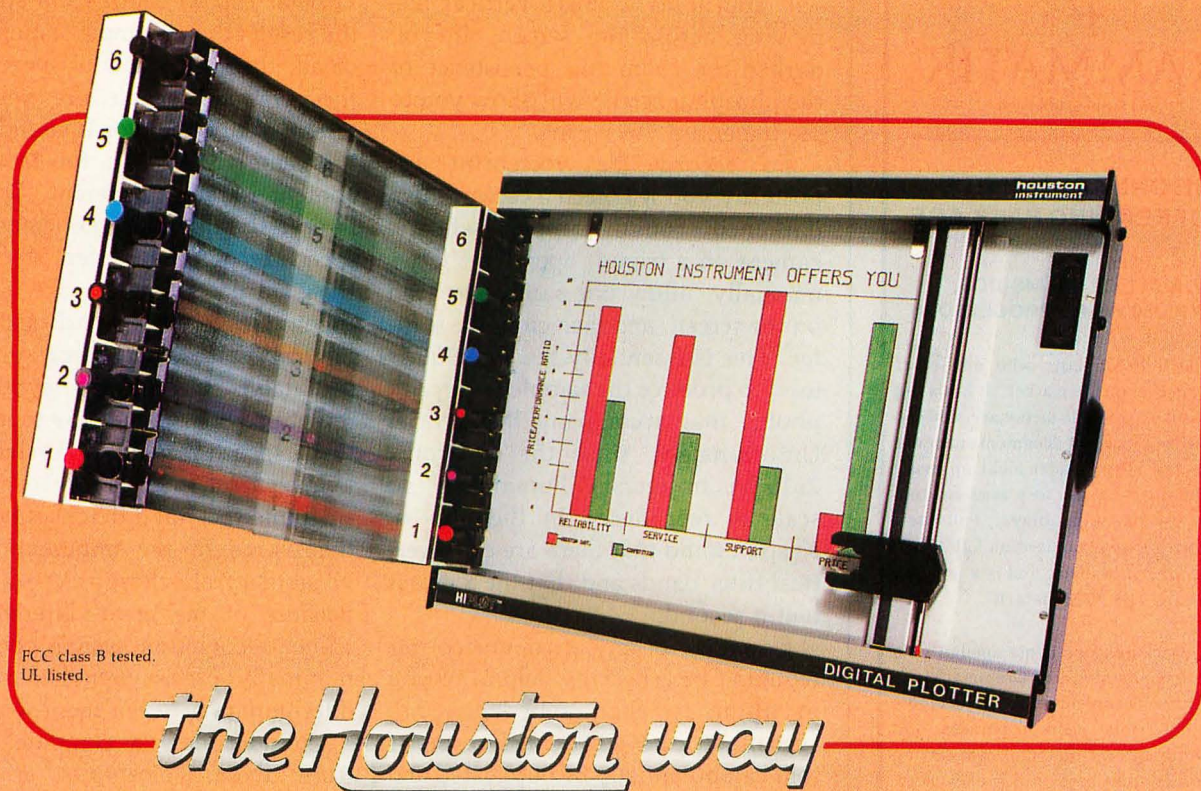




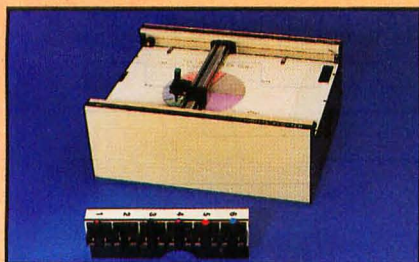
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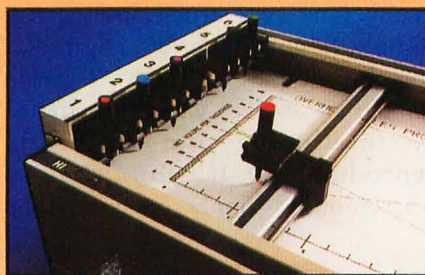
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the gain until the display appears to respond as you speak a word. Continue this adjustment until the display looks like the sample photos.

In bright ambient light the display will appear as a single vertical line moving across the screen. If you darken the room, the persistence of the phosphor screen will allow you to see the entire voiceprint.

To record the voiceprint for posterity you will need a camera. In a darkened room, simply set the camera on a tripod, open the shutter manually, allow one sample to scan on the screen, and then close the shutter. This is essentially the technique I used to produce the sample voiceprint photos that accompany this article. Unfortunately, since the Tektronix 2215 has no reticule illumination, no scale is reproduced in the photos. Keep in mind that there are eight vertical filter bands and that the x axis is half a second.

Examples of my own voiceprints wouldn't be especially helpful to you in trying to align your voiceprint system, so I have provided examples that can potentially be duplicated and compared. All the voiceprint photos here were produced using the output of a Micromouth voice synthesizer. The Micromouth, which I described in my June 1981 article, uses a National Semiconductor Digitalker speech-synthesis chip set. It has a limited vocabulary which is extremely intelligible and eminently reproducible. If you have a Micromouth, simply connect it up

and compare your results to the various prints of words and numbers shown here.

## Experimental Results

What can we learn from studying the results of our simple testing? First of all, the voiceprints of speech synthesizers and people are very different. While the words sound much the same to the ear, the frequency content is rather different. This difference should not bother a computer speech-recognition system so long as the word templates are set to recognize either synthesized or natural voices. But because of its repeatable speech, the synthesizer might provide a good way to initially test a speech-recognition system.

In general, there seem to be considerable spectral differences between the words in the minimum useful vocabulary I chose as examples. Because of the great differences, a speech-recognition system could use minimally precise template data to differentiate between these words.

Consider how a computer could store these voiceprints as word templates. An A/D converter could be used to read the filter values. Storing the output values from 128 scans of eight filters requires 1024 (1K) bytes for each word, assuming the use of an 8-bit A/D converter. The amount of memory required can be reduced by eliminating the dead air time at the beginning of words and between the sounds contained within a word.

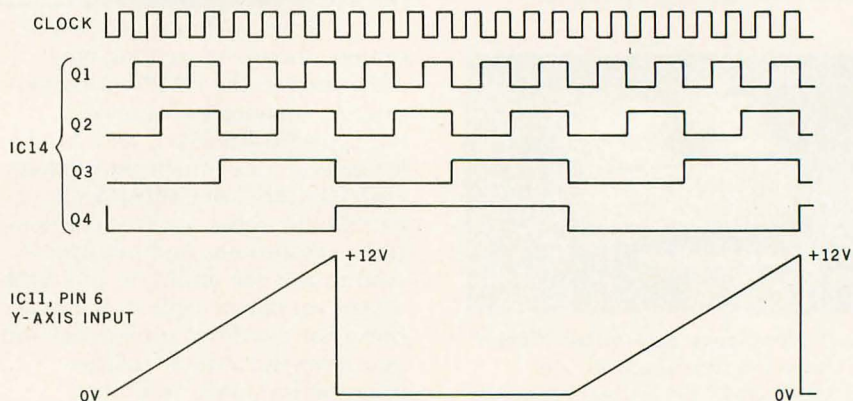


Figure 6: Timing diagram of the voiceprint-recording system.



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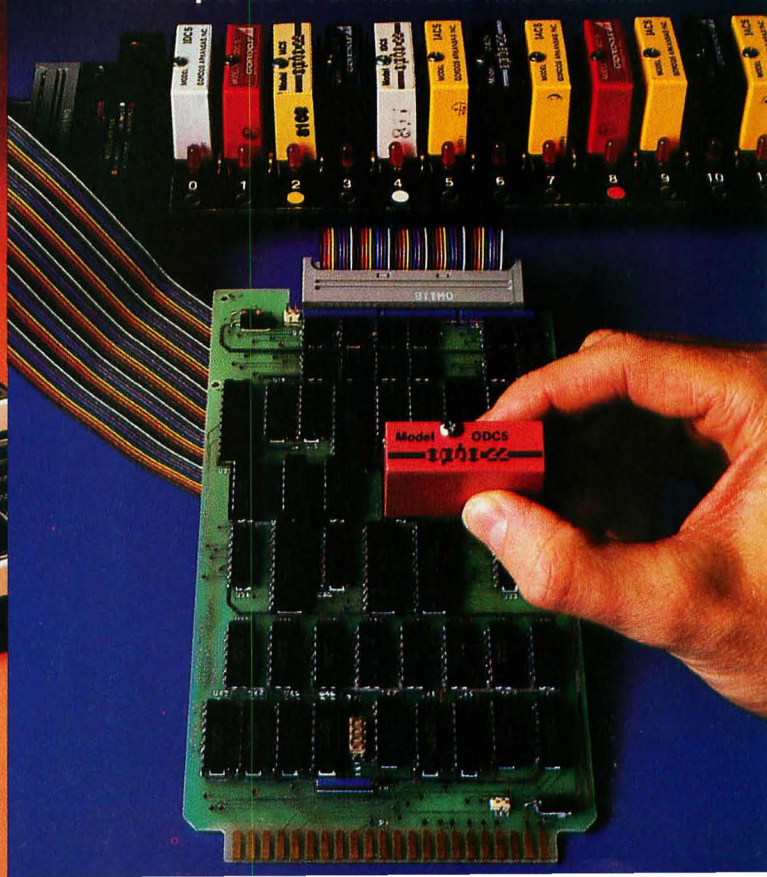
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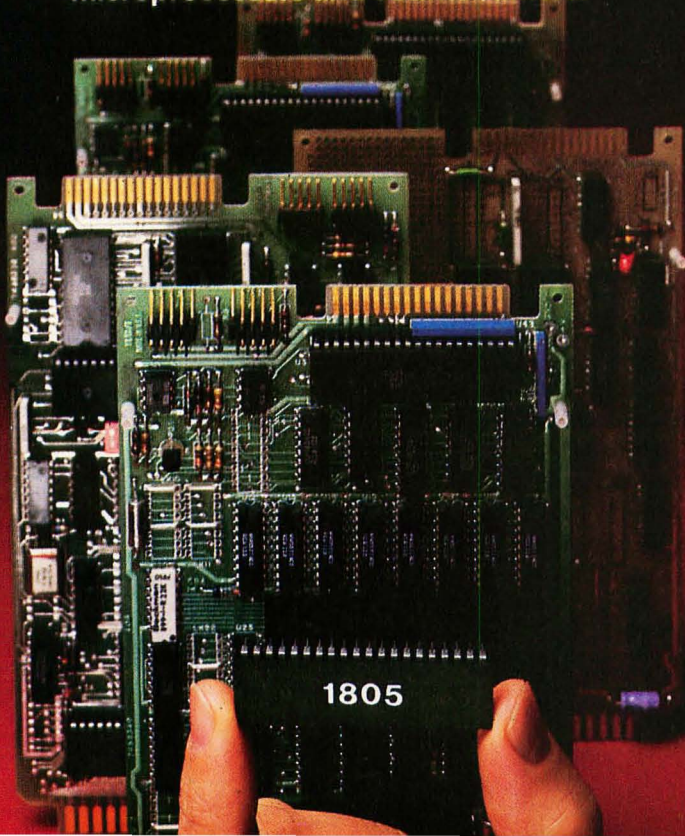
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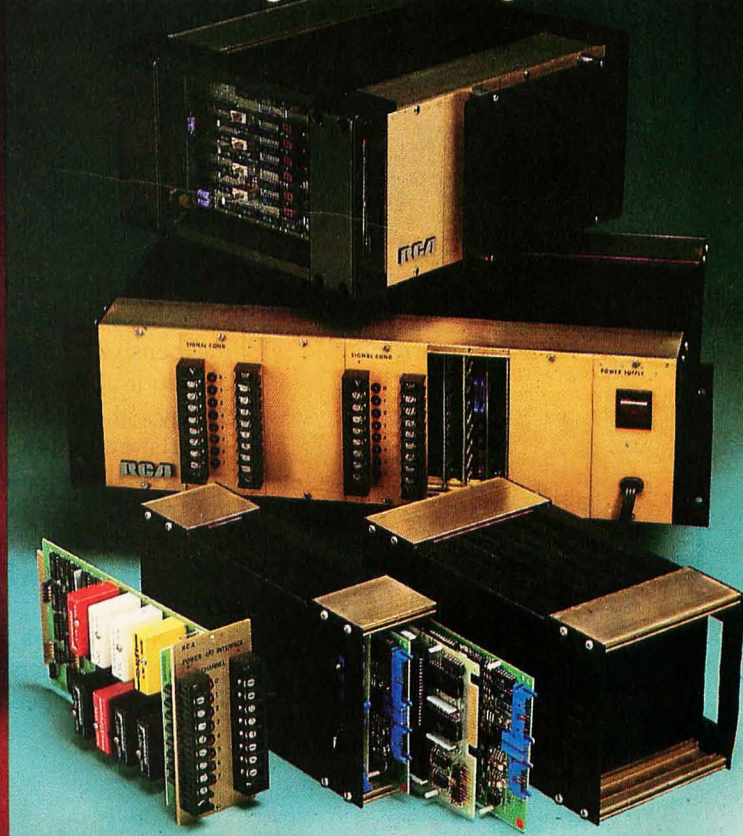
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Perhaps storing the output amplitude of the filters is unnecessary, and a simple threshold detector would be sufficient. A logic 1 could indicate that there is some spectral content in that frequency range while a logic 0 indicates none. The eight instantaneous filter outputs could then be stored in a single byte rather than eight. This translates into a memory requirement of 128 bytes per sample period. This presumes that information about the frequency content of speech with respect to time is more important than information about the amplitude of the energy in the different frequency bands. I think it will depend a lot upon the vocabulary chosen.

Finally, I saw little activity in either the 31-Hz or the 4-kHz band in speech both from my own voice and from the Micromouth. This may be a limitation of the hardware, but I think it would be safe to eliminate these passbands from any voice-response system. In my experience, the three frequency ranges that seem to always contain the most energy are about 60 Hz to 200 Hz, 200 Hz to 500 Hz, and 1 kHz to 2 kHz. I am at present unwilling to design a speech-recognition system with only three sampling passbands, but I'm still gathering data.

### In Conclusion

I haven't yet decided how I will configure my speech-recognition system. I have only one major design criterion so far: because writing comprehensive software algorithms isn't among my greatest pleasures in life, I will attempt to do as much in hardware as I can.

Perhaps if I stall long enough a few inexpensive integrated circuits that can do it all will emerge from Silicon Valley. I have heard promising reports on a few such products. I know of the intense interest many of my readers have in the subject, and I intend to build a speech-recognition system as soon as I can make it cost-effective.

I hope that this article has at least helped you understand some of the first steps in speech recognition. If

you are talented in software, you may have been inspired with an idea that will make the process easy. But at any rate, I hope to have helped allay any suspicions that computerized voice response is a black art.

### Next Month:

*New technological developments have made infrared light a convenient medium for remote-control or data transmission. We'll explore how to use it. ■*

### References

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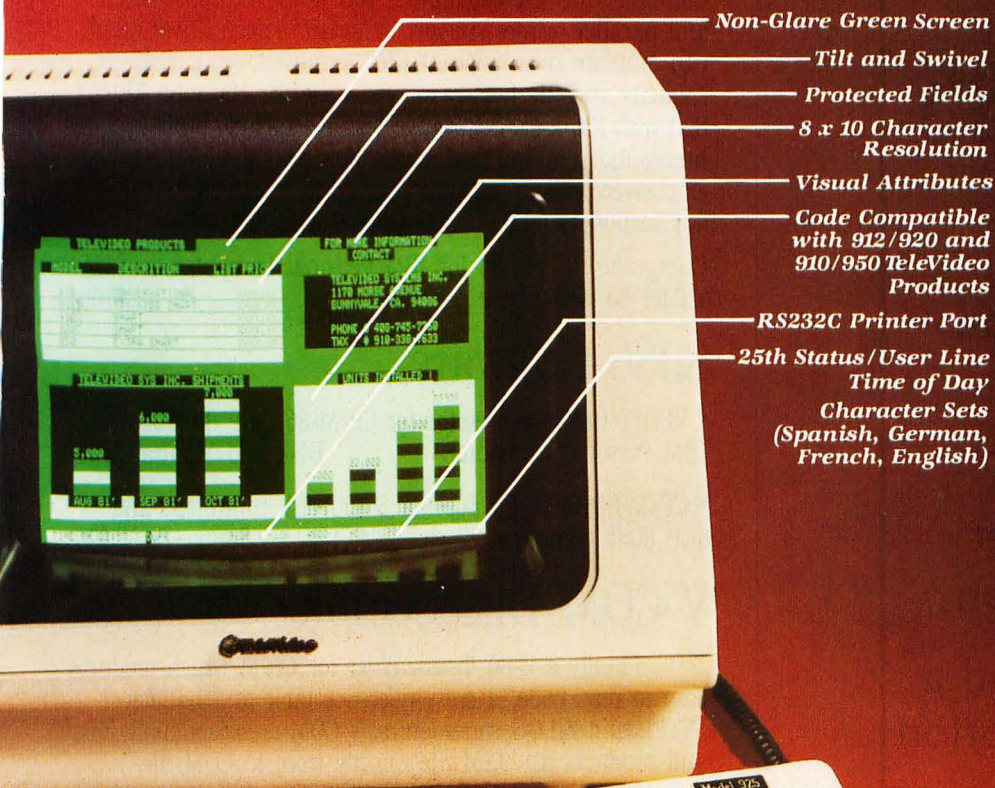
**Editor's Note:** Steve often refers to previous *Circuit Cellar* articles as reference material for each month's current article. Most of these past articles are available in reprint books from *BYTE Books*, 70 Main St., Peterborough, NH 03458. Ciarcia's *Circuit Cellar*, Volume I, covers articles that appeared in *BYTE* from September 1977 through November 1978. Ciarcia's *Circuit Cellar*, Volume II, contains articles from December 1978 through June 1980. Ciarcia's *Circuit Cellar*, Volume III, contains the articles that were published from July 1980 through December 1981.

To receive a complete list of Ciarcia's *Circuit Cellar* project kits available from the Micromint, circle 100 on the reader-service inquiry card at the back of the magazine.



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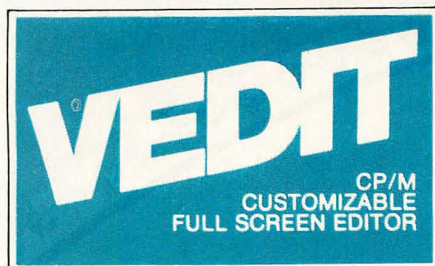
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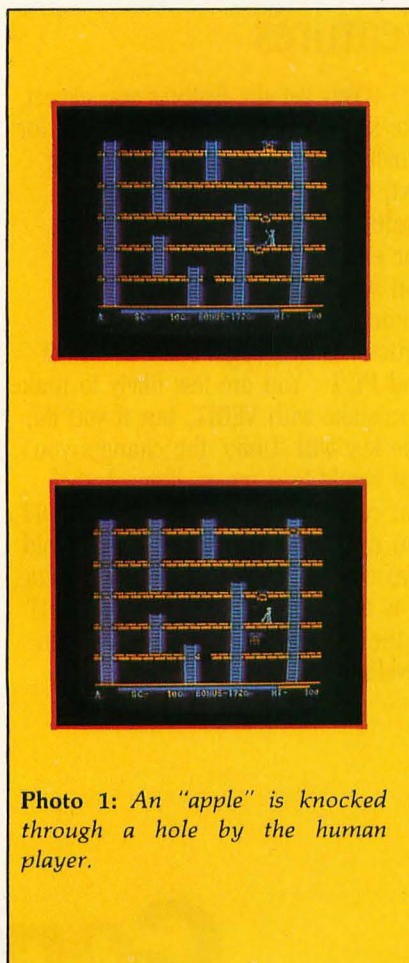
# BYTES ARCADE

## Apple Panic

Gregg Williams  
Senior Editor

Personality—it's a major factor in distinguishing arcade best-sellers from the ones that lie around gathering dust in a corner. In coin-operated arcade games, it is not the only factor in determining success—anything with enough color, sound, and action will attract an adequate following. However, personality is a greater factor in microcomputer-based arcade games because they have fewer distracting frills. Of the many games I've seen in the past six months, Apple Panic has far more personality than any of several equally well-done games for the Apple II or II Plus microcomputers. Additionally, Apple Panic is an original game. It is not just a simplified copy of a coin-operated game. As a game that's available *only* for microcomputers, you can show it off to coin-op game snobs.

Like many successful arcade games, Apple Panic has a simple but eccentric premise. Your player is trapped in a world of walkways and ladders. The objective is to keep your player alive as long as possible. Of course, no arcade game is complete without a merci-



**Photo 1:** An "apple" is knocked through a hole by the human player.

less enemy, and Apple Panic is no exception. Your enemies are a number of flattened "apples" (similar to Terrapin Turtle robots) that roam the walkways and ladders. They aren't terribly bright, but what they lack in intelligence they make up for in number. How do you fight back? By digging a hole in the walkway, waiting until an apple drops into it, and then knocking it through the hole to smash on the walkway below.

You control your player's movement by using the "I," "J," "K," and "M" keys. To dig a hole, hit the "A" key while your player is moving. (For some reason, your player does not always dig a hole when you want it to. Although this is probably the result of simplifying the game's algorithm to a manageable size, I look on it as a chance to develop my expertise in the game.)

Once an apple falls into the hole and sticks there, you have several seconds to return to that hole and knock the apple through by hitting the "S" key; if you line up two or more holes well enough for the apple to drop through all of them,



you get bonus points that increase with each extra hole used. When an apple falls through a hole, the walkway is mysteriously repaired; see photos 1a and 1b. (You didn't expect this to be easy, did you?) In addition, if you don't get to a stuck apple in time, the dumb but industrious critter pulls itself out of the hole and repairs the walkway.

Although the apples are slow, they don't waste any opportunities. If they get close enough, they pounce on and eat your player. The screen is then redrawn with a different arrangement of ladders and apples, and you start over. On successive screens, you usually get more apples on the screen. If you get good enough, two new predators, the Green Butterfly and the Mask of Death, appear; the latter appears only if you are *very* good. You get more points for killing them, but they are more difficult to kill. The Butterfly must drop through two holes

before it is eliminated; if it drops from one hole to the walkway immediately below, it continues walking as if nothing had happened. (You get an extra player life when you kill a Butterfly.) The Mask of Death is even more difficult to kill; it must fall through *three* holes before it is destroyed.

One final note on the mechanics of the game: your player can fall through a hole without injury. This is sometimes useful as an escape route because the apples can't follow.

### Strategy

Timing is very important in this game. It takes a certain amount of time to dig a hole or knock an apple through a hole. If you underestimate the amount of time needed when an apple is nearby, it may get you before you get it.

Another element of your strategy is the placement of holes with respect to ladders. On one hand, you like to have a hole between you and every apple. On the other hand, if an apple falls into a hole on the other side of the screen, those same holes may prevent you from getting to the trapped apple in time. After hastily digging a hole, you may find that it is now impossible to get to an entire section of the screen. Also, the strategy of going to the end of a walkway, digging a hole between you and the center of the screen, and waiting for an apple to come after you usually doesn't work—the apples aren't smart enough to sense you unless you are nearby.

### Conclusions

Apple Panic is an interesting, playful game. It is interesting to note that, like Pac-Man (a game similar in spirit), it uses engulfment as the main form of destruction. This is very different from the majority of games, which have objects shooting projectiles at each other.

Apple Panic makes good use of both graphics and sound. When walking, the player does not flicker (as it would with less skillful animation). Nearly constant sound effects keep the ear entertained without assaulting it.

Even when played by a novice, this game usually lasts longer than most other arcade-style games. Although the apples will eventually overwhelm you, split-second reflexes are not as important here as they are in other games. A normal game of Apple Panic lasts from five to fifteen minutes; it lasts longer as you get better. Therefore, while still being entertaining and engaging, Apple Panic will not leave you a nervous wreck when the game is over. (Well, less of one, anyway.)

I do have a criticism, however. This game does not have the features that allow you to indefinitely pause while you turn the sound effects off. Granted, one game can't have everything, but these easily implemented features are becoming more common on Apple games. Game designers should take note.

Apple Panic is a copy-protected disk that boots directly on either 13- or 16-sector Apple computers. Broderbund Software pledges to replace the disk free of charge if it fails to boot and to replace it for a minimal charge if the disk is ever physically damaged. This is another policy that should be encouraged. It takes away many of the objections about copy-protected disks for programs of this nature.

It should be reemphasized that Apple Panic is an original game, not a copy of an arcade game. If the current trend away from microcomputer games adapted from coin-operated arcade games continues, the work of authors and companies that produce high-quality original games will become more important. ■

## At a Glance

### Name

Apple Panic

### Type

Arcade-style game

### Manufacturer

Broderbund Software  
2 Vista Wood Way  
San Rafael, CA 94901

### Price

\$29.95

### Author

Ben Serki

### Format

5¼-inch floppy disk

### Language

6502 machine code

### Computer

Apple II or II Plus with one disk drive (13 or 16 sectors) and 48K bytes of memory

### Documentation

One-page instruction leaflet

### Audience

Arcade enthusiasts of all ages



# Missile Command

Stanley J. Wszola  
Technical Editor

As your left thumb stabs at the firing button, your right hand spasmodically tries to control the cursor. You see flashes of light, hear bursts of sound, and finally it's over. You've done it, racked up your best score ever playing Missile Command. Have you ever wondered why Missile Command is such a popular game? Despite the claims of Atari that its

development was a long process, there are other reasons for its success. In this review, I'd like to touch lightly upon some of these reasons.

If you have never pumped a quarter into a video arcade game, or don't own an Atari 400 or 800 microcomputer, I'll briefly describe the game. The Missile Command game for the Atari 400 and 800 is an

adaptation of the commercial arcade game. You become the commander of a missile base with armaments consisting of ABMs (antiballistic missiles). You must preserve your six cities and missile base from nuclear attack by destroying the incoming enemy missiles and bombs.

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CP/M; MP/M—trademarks of Digital Research, Inc. OASIS—trademark of Phase One Systems, Inc.

## At a Glance

### Name

Missile Command

### Type

Arcade-type game

### Manufacturer

Atari Inc.  
1265 Borregas Ave.  
Sunnyvale, CA 94086  
(408) 745-2213

### Price

\$39.95

### Format

Plug-in ROM cartridge

### Language

6502 machine language

### Computer

Atari 400 or 800 with 8K bytes of RAM and joysticks

### Documentation

18-page booklet

### Audience

Any Atari computer owner who enjoys a good game



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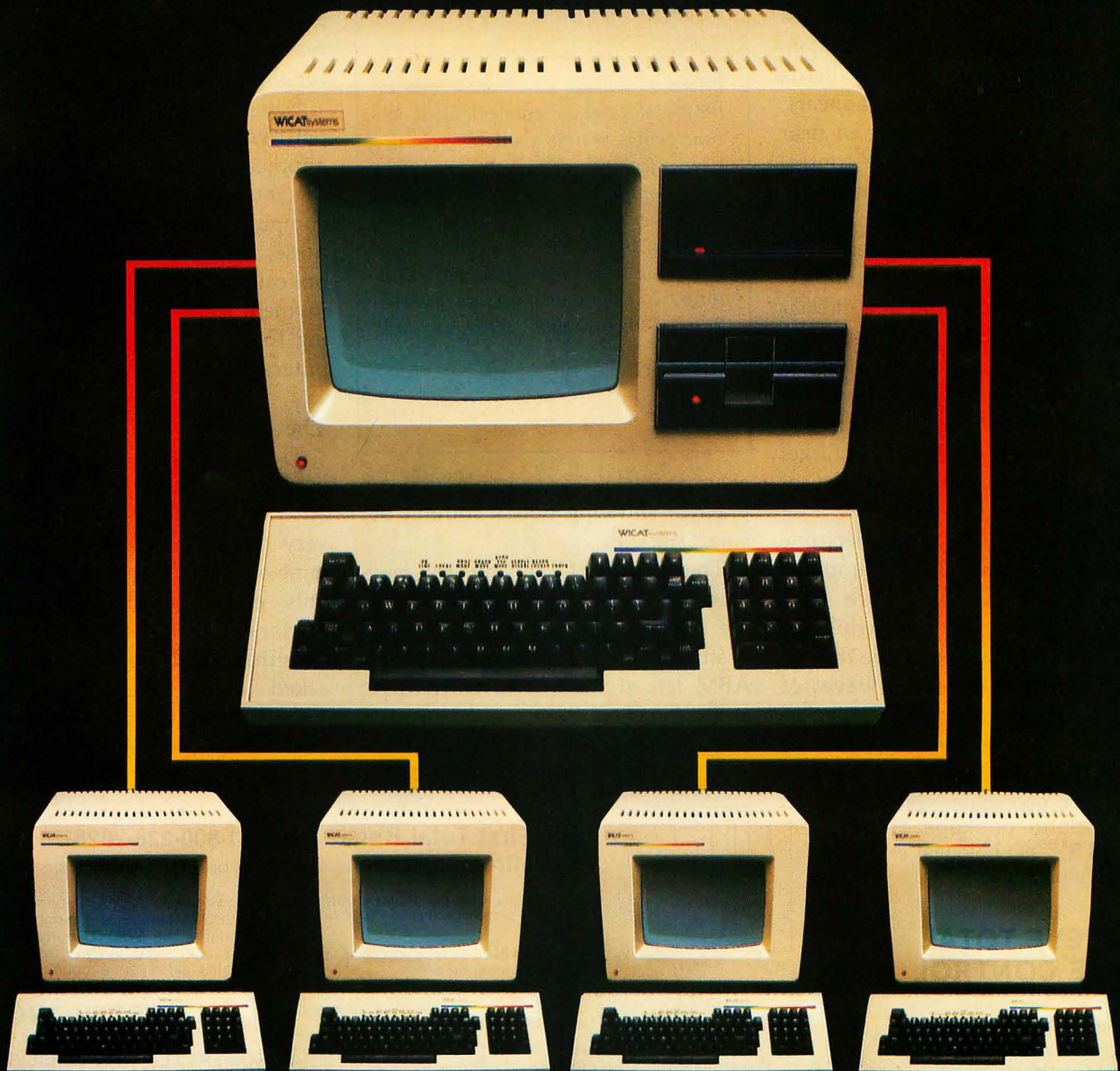
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# BYTE'S ARCADE

satellites that drop missiles, bombers, and smart missiles that can evade your ABMs and home in on their targets.

The enemy attacks come in waves. Each wave lasts from 30 to 45 seconds. The waves become increasingly more difficult as the game progresses, with the sixth wave introducing you to the smart missiles.

You are provided with 30 ABMs per wave. These are launched against targets by using the joystick to control a cursor on the screen. When a missile, bomber, or satellite appears, you position the cursor over or near the target and press the fire control button. Your missile base launches an ABM toward a detonation mark left by the cursor on the screen. The resulting atomic fireball, complete with the simulated sound of a nuclear explosion, will destroy the incoming missile or other target. That is, if your aim was true, if you allowed for a moving target, if you hadn't already used all your ABMs, and if the target wasn't smart enough to get out of your way (smart missiles).

The game allows you to select one or two players. The computer automatically keeps score and remembers the highest score while the game is continuing. You have the option of skipping the easier waves of



**Photo 1:** *Missile Command*, one of the most popular coin-operated arcade games, is now available in a cartridge for the Atari 400 and 800 microcomputers. The trackball of the coin-operated version has been replaced by an Atari joystick. Also, you have only one missile base (not three), but the sights, sounds, and action of the original game are still there.

enemy attacks. For example, you can practice shooting down nothing but smart missiles.

The object of all this nuclear mayhem is to accumulate points. Points are scored for every enemy weapon destroyed and for every city and ABM left at the end of each wave.

Every two waves, a wave point multiplier increases the value of each point by as much as six times. Every time you earn 10,000 points, you get another city to replace one that was previously vaporized.

## Why Is It Successful?

Though none of the editors on the BYTE staff advocate nuclear war, we all agree that *Missile Command* is a good game. Yet we agree for different reasons, and therein lies the reason for the game's success.

Some people enjoy the competitiveness of trying to better another person's score. Others enjoy the interaction between human and computer. And some enjoy the lights, noise, and the satisfaction of symbolically blowing things up. My enjoyment stems mostly from not having to pump quarters into the computer.

## The Critics

There are those who object to the overt violence implicit in the game. After all, the destruction of cities is a very violent activity. A friend of mine once said that games of this type only encourage the acceptance of warfare as a viable solution to problems that could be settled peaceably. I asked if he ever played chess.

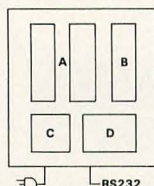
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When he said yes, I then asked if he thought his aggressive activities on the chessboard affected his actions in real life. A very spirited discussion then ensued, with neither of us convincing the other to change his views.

Whether the designers of Missile Command intended to or not, they have presented a game that reflects contemporary society. The game takes the threat of nuclear warfare and, simplifying the concept to the extreme, reduces that threat to a man-

ageable human level. Whether this familiarity with nuclear warfare is good or not, I don't know. However, it doesn't seem to have affected the popularity of the game.

## Conclusion

Missile Command is a great success, and Atari should be congratulated on producing such a high-quality product. However, it is only a temporary success. Programmers are constantly working on newer, better

games. My advice to them is to carefully examine the current successes and determine why they work. Then, taking their own original games, incorporate those ideas in their own programs.

With the advent of new microcomputers and with the foundations for software development already well established, the potential for creative programming is greater than ever. I am excitedly awaiting what's coming next. ■

# Dino Wars

George Stewart  
Technical Editor

If any computer game deserves the title "action game," this one does. Dino Wars is a two-player game in which each player controls a ferocious dinosaur that attempts to bite the other player's dinosaur until it cries uncle. Although there is no gore and the losing dinosaur always survives, the combat between the two creatures seems vicious at times.

The battle takes place on a desert plain decorated with several clumps of cactus. However, this is not your ordinary cactus. If a dinosaur mistakenly runs into one, the creature falls over and loses five units of fighting energy. Perhaps it's fossilized.

Although the terrain is much larger than the field of view displayed on the screen, it is not infinite. If a dinosaur exits to either the left or the right, it eventually reemerges on the opposite side of the screen. Even if not visible on the screen, battles can rage in full force and dinosaurs can trip over unseen cacti.

The dinosaurs are chunky creatures (low-resolution is the term used outside of the prehistoric epoch) modeled after *Tyrannosaurus rex*. One is purple, the other blue. (An alternate color set is available for variety.) Although not the most graceful of animals, they can swing their tails menacingly, open their jaws to bite, and swagger around the screen in any direction.

The game is three-dimensional. As a dinosaur recedes into the background, it becomes smaller, eventually shrinking to the size of a dot. As it advances, its size increases to a stage where it consumes much of the screen.

Joysticks are used to control the combatants. Although these joysticks permit 360 degrees of apparent control, the dinosaurs can actually move in only six directions. As a result, they appear to hop from one stance to another.

The object of the game is to bite the

## At a Glance

### Name

Dino Wars

### Type

Animated dinosaur combat game

### Manufacturer

Radio Shack  
1800 One Tandy Center  
Fort Worth, TX 76102

### Price

\$39.95

### Author

Robert Kilgus

### Format

Plug-in ROM cartridge

### Computer

TRS-80 Color Computer with two joystick controllers; 16K bytes of RAM recommended for best results

### Audience

Game fans age 6 and up



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# BYTE'S ARCADE

other dinosaur while it is vulnerable, i.e., while it has its back turned or is recovering from a nasty fall over a cactus (the Marquis of Queensberry rules don't apply in this primitive world). After sustaining an effective bite, a dinosaur falls to the ground with a resounding crash.

When two experienced players control the dinosaurs, the battle resembles an awkward ballet, with the dinosaurs constantly circling each other while vying for a shot at each other's weak point. When beginners play, the action is more likely to resemble a pastoral scene in which the two dinosaurs wander around aimlessly, occasionally engaging one another with little effect and separating again.

To make a dinosaur bite, you press the joystick button. The dinosaur issues an awesome roar as it closes its jaws on air, cactus, or the opposing dinosaur. Generating this sound is one of the more satisfying aspects of the game.

Both dinosaurs start out with 100 units of energy. Each time a dinosaur is successfully bitten in a clinch, it

loses 20 points; if bitten while recovering from a cactus fall, 10 points; falling over a cactus costs five points. The game ends when one of the dinosaurs loses all its points.

A prerequisite to enjoying this game at length is a sense of the ridiculous. Without that, you are apt to become frustrated by some of its limitations. For example, while either dinosaur is roaring, all action on the screen halts because the Color Computer's microprocessor is totally preoccupied with the task of generating the sound (a hardware limitation).

Here are bite-by-bite reports from two noteworthy dino wars.

In the first battle, one player was an expert, the other a beginner. This quite typical case corresponds to computer owner and friend. The expert player used a sneak-attack strategy: his dinosaur stayed just off-screen until the beginner's dinosaur presented a vulnerable back. Then the expert's dinosaur lunged into view, bit effectively, and retreated again. Five such attacks were enough to send the beginner's dinosaur into squeaking submission (a defeated

dinosaur always runs off yelping toward the horizon).

In the second battle, two jaded players searched for a nonviolent use of the game. The cactus provided an answer. A dinosaur can become hopelessly entangled in a cactus; each time it gets up, it immediately falls down again, losing five points each time. Accordingly, the object of this absurd battle was to be the first to expend all one's energy in mortal combat with a cactus.

Dino Wars is primarily a novelty, but a good one. It allows two players to work off all sorts of aggressions toward each other and plant life. However, it is not a game you can grow with; it doesn't take long to "peak out." It is not an intellectual game like Adventure, nor does it get your adrenaline going as does a fast-paced game of Star Raiders. Compared to one of these, you might say Dino Wars is *prehistoric*. ■

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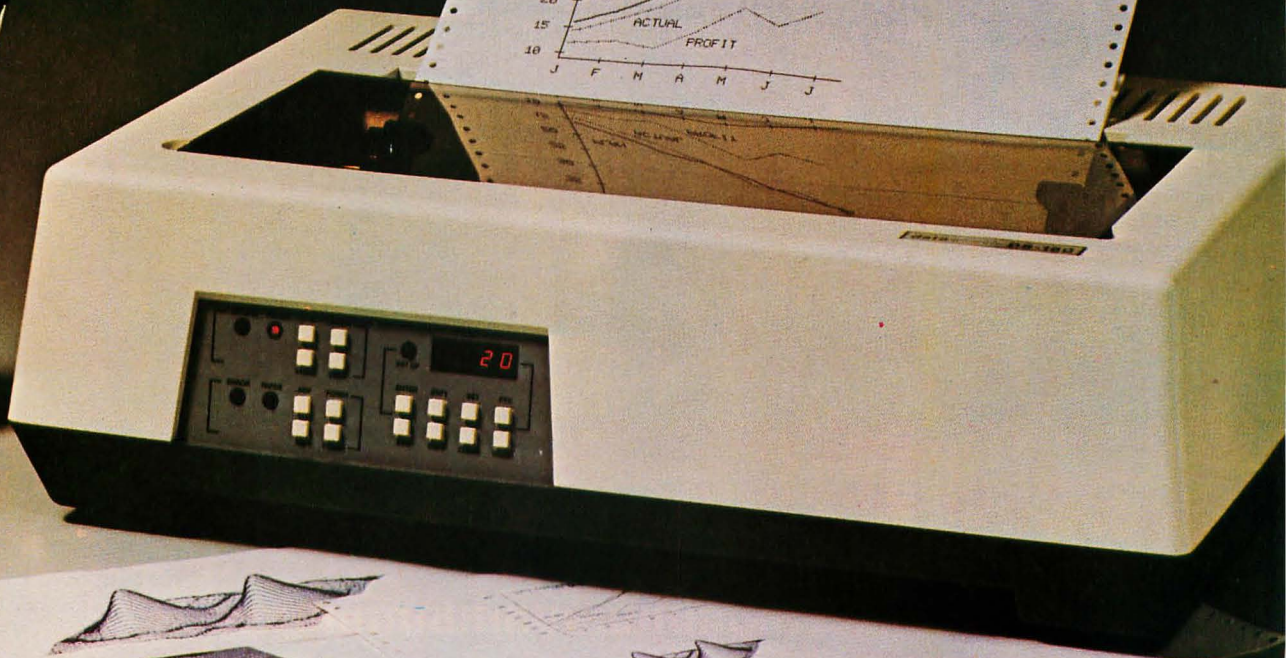
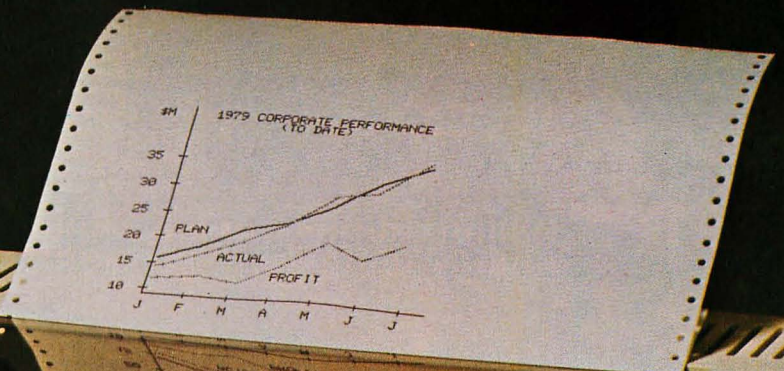
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# The Atari Tutorial

## Part 7: Sound

---

Bob Fraser  
1639 Martin Ave.  
Sunnyvale, CA 94087

---

The Atari 400 and 800 home computers have extensive hardware sound capabilities. Four independently controllable sound channels are able to play simultaneously. Each channel has a frequency register determining the note and a control register regulating the volume and the noise content. Several options allow you to insert high-pass filters, choose clock bases, set alternate modes of operation, and modify polynomial counters. This article will explain these options; next month, part 8 will show how to call these options from both BASIC and 6502 machine language.

### Definitions

For the purposes of this discussion, a few terms and conventions need to be clarified:

1 Hz (hertz)	is 1 pulse per second
1 kHz (kilohertz)	is 1000 pulses per second
1 MHz (megahertz)	is 1,000,000 pulses per second

A *pulse* is a sudden voltage rise followed somewhat later by a sudden voltage drop. If a pulse is sent to a

television speaker, it will be heard as a single pop.

A *wave*, as used here, is a continuous series of pulses. Different types of waves exist, each of which is distinguished by the shape of the in-

---

**The smaller poly  
counters repeat often  
enough to create  
droning sounds that  
rise and fall quickly.**

---

dividual pulses. Waves created by the Atari computer are square. Brass instruments typically produce triangular waves, and a human voice produces sine waves.

A *shift register* is like a memory location (in that it holds binary data) that, when so instructed, shifts all its bits to the right by one position (i.e., bit 5 will get whatever was in bit 4, bit 4 will get whatever was in bit 3, and so on). Thus, the rightmost bit is pushed out, and the leftmost bit assumes the value on its input wire (see figure 1).

"AUDFn" is read "any of the audio frequency registers, AUDF1 through AUDF4." Their addresses are, respectively, hexadecimal D200, D202,

D204, and D206 (decimal 53760, 53762, 53764, and 53766).

"AUDCn" is read "any of the audio control registers, AUDC1 through AUDC4." Their addresses are, respectively, hexadecimal D201, D203, D205, and D207 (decimal 53761, 53763, 53765, and 53767).

For the purposes of this discussion, *frequency* is a measure of the number of pulses in a given amount of time; that is, a note with a frequency of 100 Hz means that in one second exactly 100 pulses will occur. The more frequent (hence, "frequency") the pulses of a note, the higher the note. For example, a singer vocalizes at a high frequency (5 kHz), and a cow moos at a low frequency (100 Hz). The words "frequency," "note," "tone," and "pitch" are used interchangeably.

Noise and *distortion* are also used interchangeably, although their meanings are not the same. Noise is a more accurate description of the function performed by the Atari computer.

All examples are in BASIC unless

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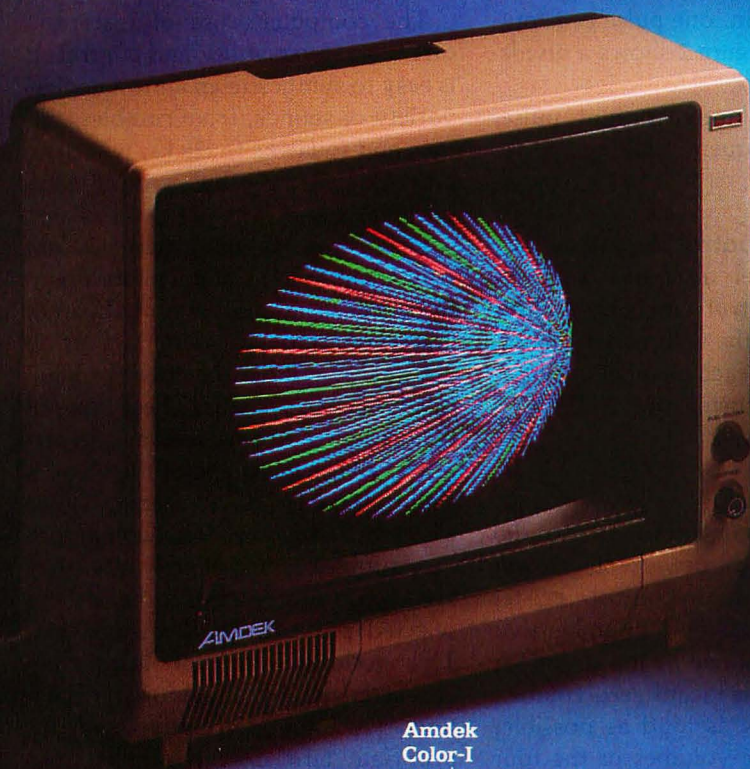
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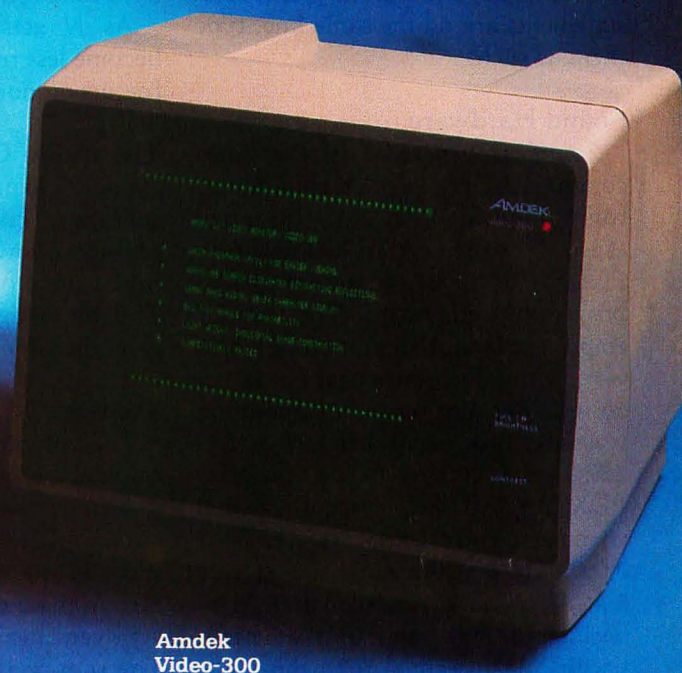
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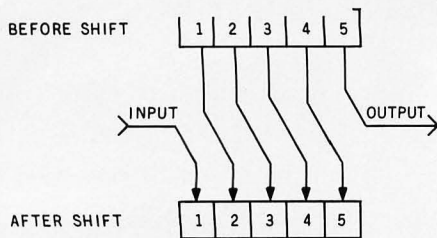
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**Figure 1:** Operation of a shift register. Here, all bits are shifted one bit to the right. As the rightmost bit is lost, some external value fills the leftmost bit.

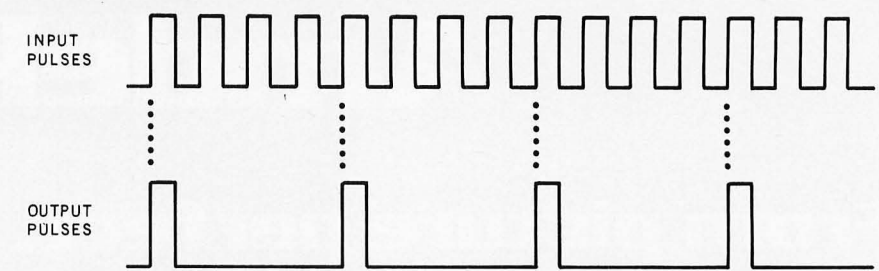
otherwise stated. Type the examples *exactly as they appear*. If there are no line numbers, don't use any; if several statements are on the same line, type them as such.

### Sound Hardware

Sound is generated in the Atari computer by the POKEY chip, a custom integrated circuit designed especially for the Atari 400 and 800; POKEY also handles the serial I/O bus and the keyboard. The POKEY chip must be initialized before it will work properly. Initialization is required after any serial bus operation (cassette, disk drive, printer, or RS-232C read/write). To initialize POKEY in BASIC, execute a null sound statement; that is, SOUND 0,0,0,0. In machine language, store a 0 at AUDCTL (hexadecimal D208 = decimal 53768) and a 3 at hexadecimal 232 (decimal 562); this is the shadow location for the SKCTL register at hexadecimal D20F (decimal 53775).

### The Audio Frequency Registers

Each of the four audio channels has a corresponding frequency register that controls the note played by the computer. The frequency register contains the number  $N$  used in a divide-by- $N$  circuit. This is not a division in the mathematical sense, but something much simpler: for every  $N$



**Figure 2:** An example of a divide-by-4 process. The circuitry for this process allows only every fourth pulse to pass through.

pulses coming in, one pulse goes out. For example, figure 2 shows a divide-by-4 function.

As  $N$  gets larger, output pulses become less frequent, making a lower frequency note.

### The Audio Control Registers

Each channel also has a corresponding control register. These registers allow the volume and distortion content of each channel to be set. The bit assignment for AUDC $n$  is given in table 1.

#### Volume

The volume control for each audio channel is straightforward. The lower 4 bits of the audio-control register (AUDC $n$ ) contain a 4-bit number that specifies the volume of the sound. A zero in these bits means zero volume; a fifteen means as loud as possible. The sum of the volumes of the four channels should not exceed thirty-two because this forces overmodulation of the audio output. The sound produced tends to actually lose volume and assume a buzzing quality.

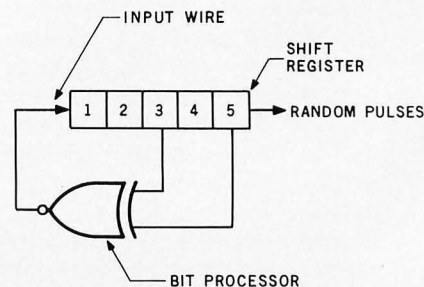
#### Distortion

Table 1 also shows that each channel has three distortion-control bits in its audio-control register. Distortion is used to create special sound effects any time a pure tone is undesirable.

The computer's use of distortion offers great versatility and control. It is easy to synthesize an almost endless variety of sounds, from rumbles, rattles, and squawks to clicks, whispers, and mood-setting background tempos.

Distortion, as used here, is not equivalent to the standard interpretation. For example, *intermodulation distortion* and *harmonic distortion* are quality criteria specified for high-fidelity stereo systems. These types of distortion refer to waveform degeneration, where the shape of the wave is slightly changed due to error in the electronic circuitry. The computer's distortion does not alter waves (they are always square), but rather deletes selected pulses from the waveform. This technique is not adequately characterized by the word "distortion." A more descriptive and appropriate term for these distortion methods is "noise."

Before you can fully grasp what we



**Figure 3:** An example of a poly counter. By letting the new leftmost bit be determined by some algorithm (here, an exclusive NOR of bits 3 and 5), a poly counter can produce a semirandom stream of bits. The pattern of the bits will eventually repeat, but the length of the pattern depends on the width in bits of the poly counter.

AUDC $n$ Bit Number	7	6	5	4	3	2	1	0
Use	distortion			volume-only bit	volume			

**Table 1:** Bit usage in the AUDC $n$  registers (AUDC1 through AUDC4).



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—	Business Graphics	—	Business Graphics
Communications	Communications	Communications	Communications
—	—	—	Apple II software library
CP/M® library	CP/M® library	CP/M® 86 programs	CP/M® library (available Spring, 1982)

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mean by distortion, you must understand *polynomial counters* (also called *poly counters*). Poly counters are employed in the Atari computer as a source of random pulses used in noise generation. The Atari computer's poly counters utilize a shift register working at 1.79 MHz. The shift register's contents are shuffled and fed back into the input; this produces a semirandom sequence of bits at the output of the shift register.

For example, in figure 3, the old value of bit 5 will be pushed out of the shift register to become the next output pulse, and bit 1 will become a function of bits 3 and 5.

The bit processor gets values from certain bits in the shift register (in figure 3, bits 3 and 5) and processes them in a way irrelevant to this discussion. It yields a value that becomes bit 1 of the poly counter's shift register.

These poly counters are not truly random because they repeat their bit sequence after a certain span of time. As you might suspect, their repetition rate depends upon the number of bits in the poly counter; in other words, the longer ones require many cycles before they repeat, while the shorter ones repeat more often.

On the Atari computer, distortion is achieved by using random pulses from these poly counters in a *selection circuit*. This circuit is actually a digital comparator, but the term "selection circuit" is more descriptive. The only pulses making it through the selection circuit to the output are those coinciding with a random pulse. Various pulses from the input are thereby eliminated in a random fashion. Figure 4 illustrates this selection method. A dotted line connects pulses that coincide.

The net effect is this: some pulses from the frequency-divider circuit are deleted. Obviously, if some of the pulses are deleted, the note will sound different. This is how distortion is in-

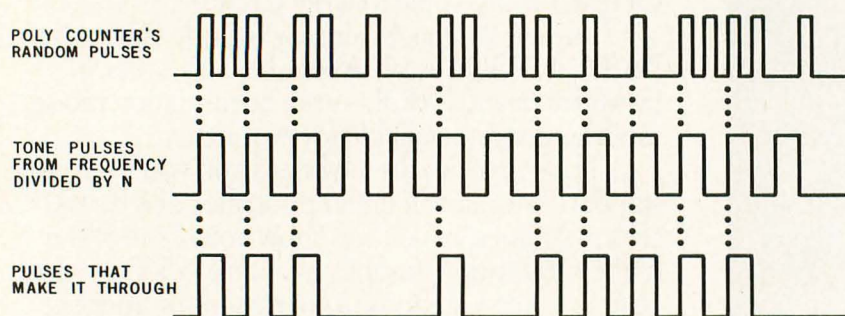
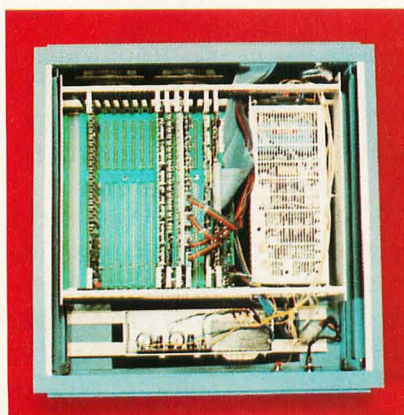


Figure 4: Using the output of a poly counter to create a noisy tone. The resulting sound of the output pulse train is considerably modified by using the poly counter output to select pulses from a pure square-wave input.

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troduced into a sound channel.

Because poly counters repeat their bit sequences, their output pattern of pulses is cyclic. And since the selection circuit uses this output pattern to delete pulses from the original note, the distorted note will contain the same repetitious pattern. This allows the hardware to create noises such as drones, motors, and other sounds having repetitive patterns.

The Atari computer is equipped with three poly counters of different lengths, which can be combined in many ways to produce interesting sound effects. The smaller poly counters (4 and 5 bits long) repeat often enough to create droning sounds that rise and fall quickly; the larger poly counter (17 bits long) takes so long to repeat that no pattern to the distortion can be readily discerned. This 17-bit poly counter can be used to generate explosions, steam, and any sound where random crackling and popping is desired. It is even irregular enough to generate *white noise* (an audio term meaning a hissing sound).

Each audio channel offers six distinct combinations of the three poly counters, which are listed in table 2. These upper AUDCn bits control three switches in the audio circuit as shown in figure 5. This diagram will help you understand why table 2 is structured as it is.

Each combination of the poly counters offers a unique sound. Furthermore, the distorted sounds can sound quite different at different frequencies. For this reason, some trial and error is necessary to find a combination of distortion and frequency that produces the desired sound effect. Table 3 gives you some rough guidelines with which you can begin your experimentation.

### Volume-only Sound

Bit 4 of AUDCn specifies the volume-only mode. When this bit is set, the volume value in AUDCn bits 0 through 3 is sent directly to the television speaker; it is not modulated with the frequency specified in the AUDFn registers.

To fully understand the use of this

mode of operation, you must understand how a speaker works and what happens to the television speaker when it receives a pulse. Any speaker has a cone that moves in and out. The cone's position at any time is directly proportional to the voltage it is receiving from the computer at that

time. If the voltage sent is zero, the speaker is in the resting position. Whenever the cone changes position, it moves air that is detected by your ear as sound.

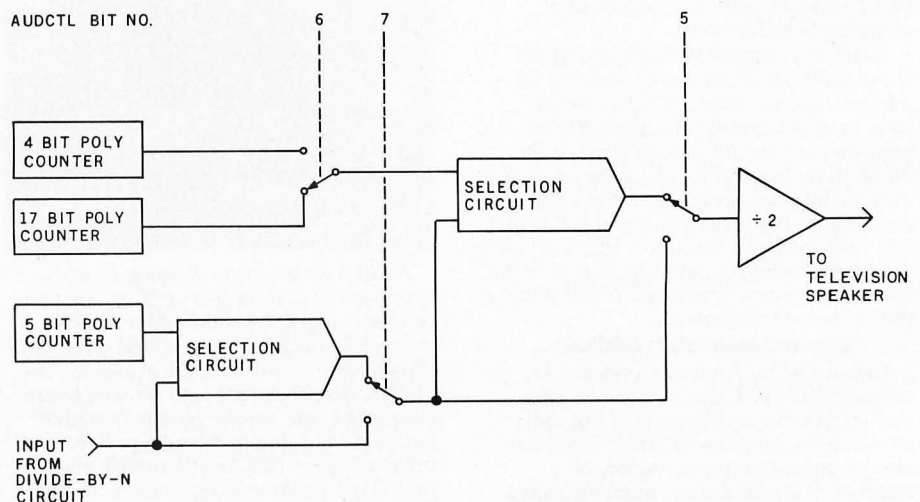
From our definition of a pulse, you know that it consists of a rising voltage followed by a falling voltage.

AUDCn Bit	7	6	5	Type of Distortion Carried Out
0	0	0	0	Divide clock by frequency, select using 5-bit then 17-bit poly counter, then divide by 2
0	X	1	1	Divide clock by frequency, select using 5-bit poly counter, then divide by 2
0	1	0	0	Divide clock by frequency, select using 5-bit then 4-bit poly counter, then divide by 2
1	0	0	0	Divide clock by frequency, select using 17-bit poly counter, then divide by 2
1	X	1	1	Divide clock by frequency, then divide by 2 (no poly counters used)
1	1	0	0	Divide clock by frequency, select using 4-bit poly counter, then divide by 2

**Table 2:** Types of distortion available from the Atari 400/800. See table 1 for the usage of other bits in each AUDCn register. An "X" in the second column of the table represents a bit that can be either 0 or 1.

AUDCn Bit	7	6	5	Low frequencies	Middle frequencies	High frequencies
0	0	0	0	Geiger counter	raging fire	rushing air steam
0	X	1	1	machine gun	auto at idle	electric motor power transformer
0	1	0	0	calm fire	laboring auto	auto with a "miss"
1	0	0	0	building crashing in	radio interference	waterfall
1	X	1	1	pure musical tones		
1	1	0	0	airplane	lawn mower	electric razor

**Table 3:** Types of sounds available from the six types of distortion available from each AUDCn register. An "X" in the second column of the table represents a bit that can be either 0 or 1.



**Figure 5:** A schematic representation of the effects of bits 5 through 7 of the AUDCTL register on the sound sent to the television speaker.





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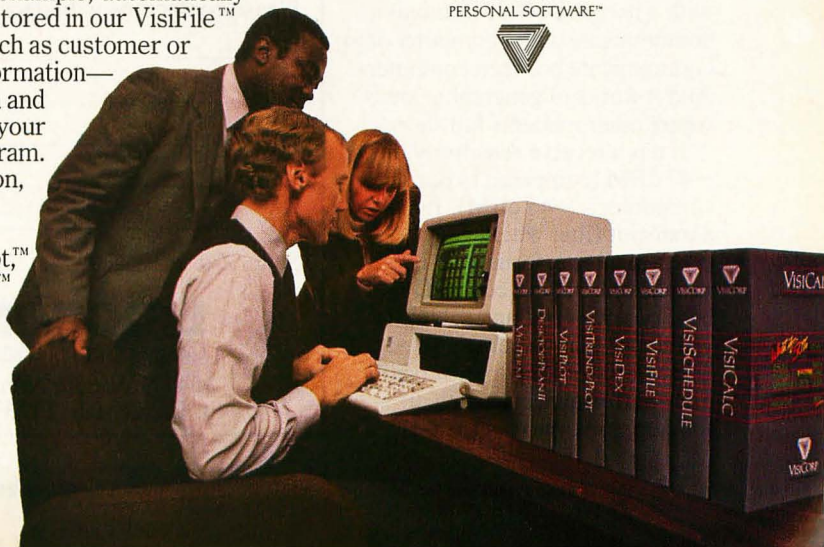
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If you sent the speaker a pulse, it would push out with the rising voltage and pull back with the falling voltage, resulting in a wave of air that can be detected by your ear as a pop. The following statements produce such a pop on the television speaker by sending a single pulse:

```
POKE 53761,31:POKE 53761,16
```

A stream of pulses (or wave) would set the speaker into constant motion, and a continuous buzz or note would be heard. The faster the pulses are

sent, the higher the note. This is how the computer generates sound on the television speaker.

It is essential to note that in the volume-only mode the volume sent does not drop back to zero automatically, but remains constant until the program changes it. The program should modulate the volume often enough to create a noise. Now try the following two statements, listening carefully after each:

```
POKE 53761,31
POKE 53761,31
```

```
POKE 53761,16
POKE 53761,16
```

As before, you heard a pop the first time as the speaker moved back to its resting position, and you heard nothing the second time because the speaker was already in the resting position.

Thus, the volume-only bit gives the program complete control over the position of the speaker at any time. Although the examples given above are only binary examples (either on or off), you are by no means limited to this type of speaker modulation. You can set the speaker to any of 16 distinct positions.

For example, a simple triangle wave (similar to the waveform produced by brass instruments) could be generated by sending a volume of 8 followed by 9, 10, 11, 10, 9, 8, 7, 6, 5, 6, 7, and back to 8, then repeating this sequence over and over very rapidly. By changing the volume quickly enough, virtually any waveform can be created. It is feasible, for example, to perform voice synthesis using this technique. However, this requires the use of assembly language. There is more discussion of this bit in part 8 of this series.

## AUDCTL

In addition to the independent channel-control bytes (AUDCn), an option byte (AUDCTL) affects all four channels. Each bit in AUDCTL is assigned a specific function, as shown in table 4. AUDCTL is at location D208 hexadecimal, 53768 decimal.

## Clocking

Before proceeding with the explanations of the AUDCTL options, a

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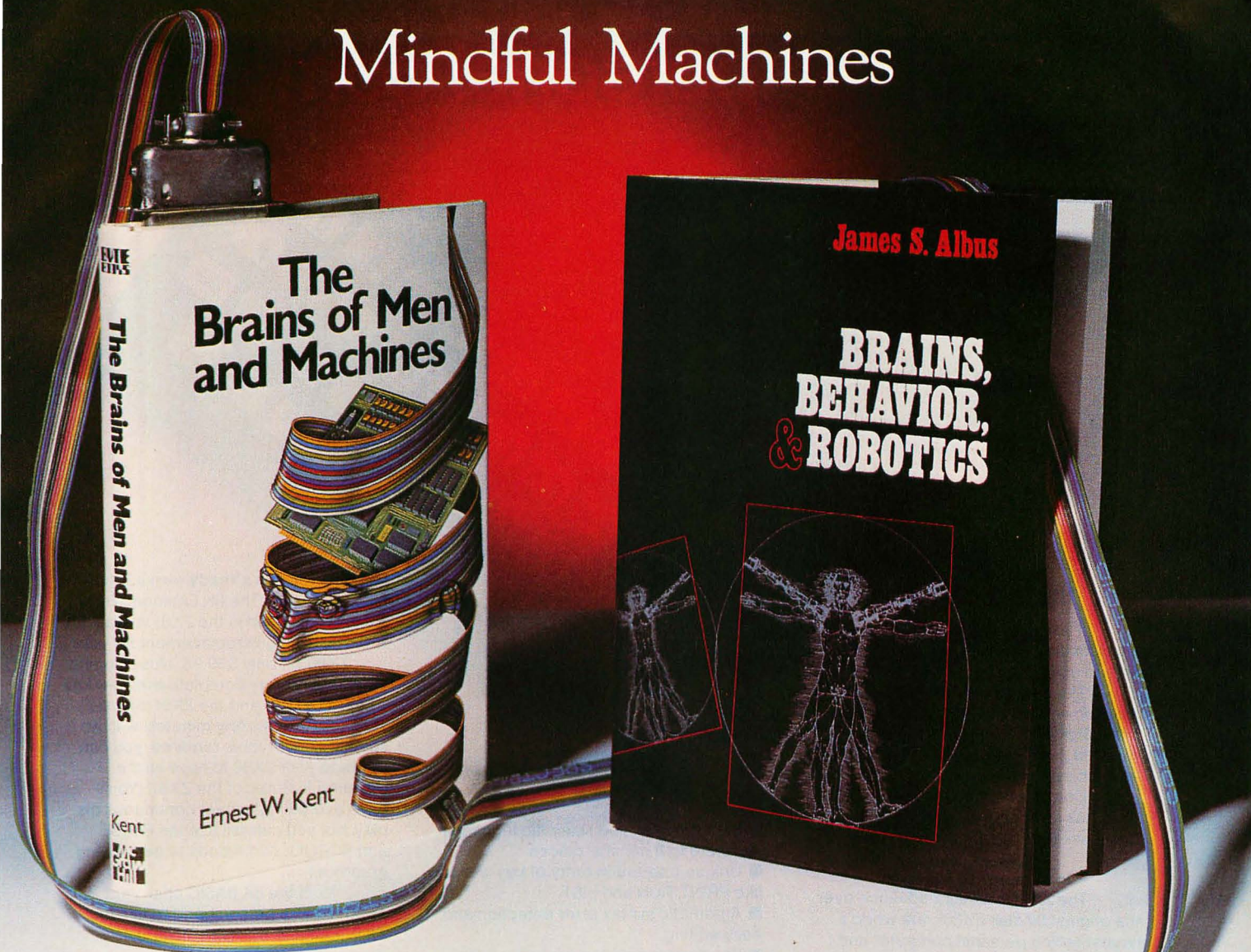
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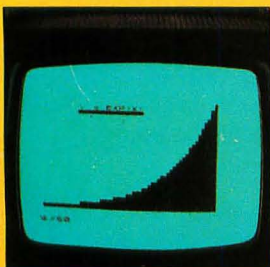
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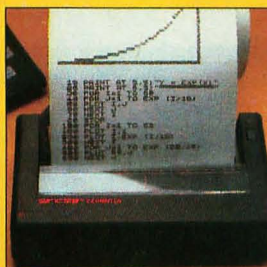
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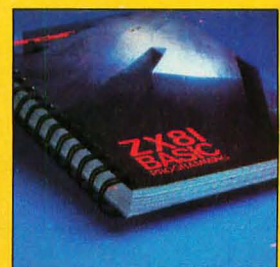
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AUDCTL Bit	Function Performed If Bit Set
0	Switches the main clock base from 64 kHz to 15 kHz
1	Inserts high-pass filter into channel 2, clocked by channel 4 (only frequencies higher than that of channel 4 are passed by the filter)
2	Inserts high-pass filter into channel 1, clocked by channel 3 (only frequencies higher than that of channel 3 are passed by the filter)
3	Joins channel 4 to channel 3 to give 16-bit resolution
4	Joins channel 2 to channel 1 to give 16-bit resolution
5	Clocks channel 3 with 1.79 MHz
6	Clocks channel 1 with 1.79 MHz
7	Makes the 17-bit poly counter into a 9-bit poly counter

**Table 4:** Modifications to the sound-generation registers available by manipulation of the bits in register AUDCTL (location D208 hexadecimal, 53768 decimal). Bit 7 is the most significant bit in the register.

new concept must be explained: clocking. In general, a clock is a train of pulses used to synchronize the millions of internal operations occurring every second in any computer. The central clock pulses continuously, each pulse telling the circuitry to perform another step in its operations. You may remember that a divide-by- $N$  frequency divider outputs one pulse for every  $N$ th input

pulse. You also may have wondered where the input pulses come from. One main input clock runs at 1.79 MHz; it can provide the input pulses. Also, several secondary clocks can be used as input clocks. The AUDCTL register allows you to select the clock used as the input to the divide-by- $N$  circuit. If you select a different input clock, the output from the frequency divider will change drastically.

For example, imagine that you are using the 15-kHz clock, with the frequency register set to divide by 8. The rate of output pulses from the divide-by- $N$  circuit would be about 2 kHz. But if you changed the selection of clocks to get the 64-kHz clock and did not change the frequency register, what would happen? The divide-by- $N$  would still be putting out one pulse for every eighth input pulse, but the input rate would be 64 kHz. The result is an output frequency (from the divide-by- $N$ ) of 8 kHz. Thus, you can see that reclocking changes the frequency independent of the frequency register and on a larger scale.

The formula for the output frequency (from the divide-by- $N$ ) is quite simple:

$$\text{Output frequency} = \frac{\text{Clock}}{N}$$

Setting bit 0 of the AUDCTL register switches from the 64-kHz clock to the 15-kHz clock. Note that if this bit is set, every sound channel clocked with the 64-kHz clock will instead use the 15-kHz clock. Similarly, by setting bits 5 or 6, you can clock channels 3 or 1, respectively, with 1.79 MHz. This will produce a much higher note, as demonstrated by the following example:

SOUND 0,255,10,8  
POKE 53768,64

The SOUND statement causes channel 1 to give a low tone, and the POKE sets AUDCTL bit 6 to 1, causing the pitch generated by channel 1 to jump to a much higher note.

#### 16-Bit Frequency Options

The 8 bits of resolution in the frequency-control registers normally provide more than adequate resolution for the task of selecting any desired frequency. There are, however, situations in which 8 bits are inadequate. Consider what happens when you execute the following statements:

```
FOR I=255 TO 0 STEP -1:
  SOUND 0,I,10,8:NEXT I
```

Initially, the sound rises smoothly,

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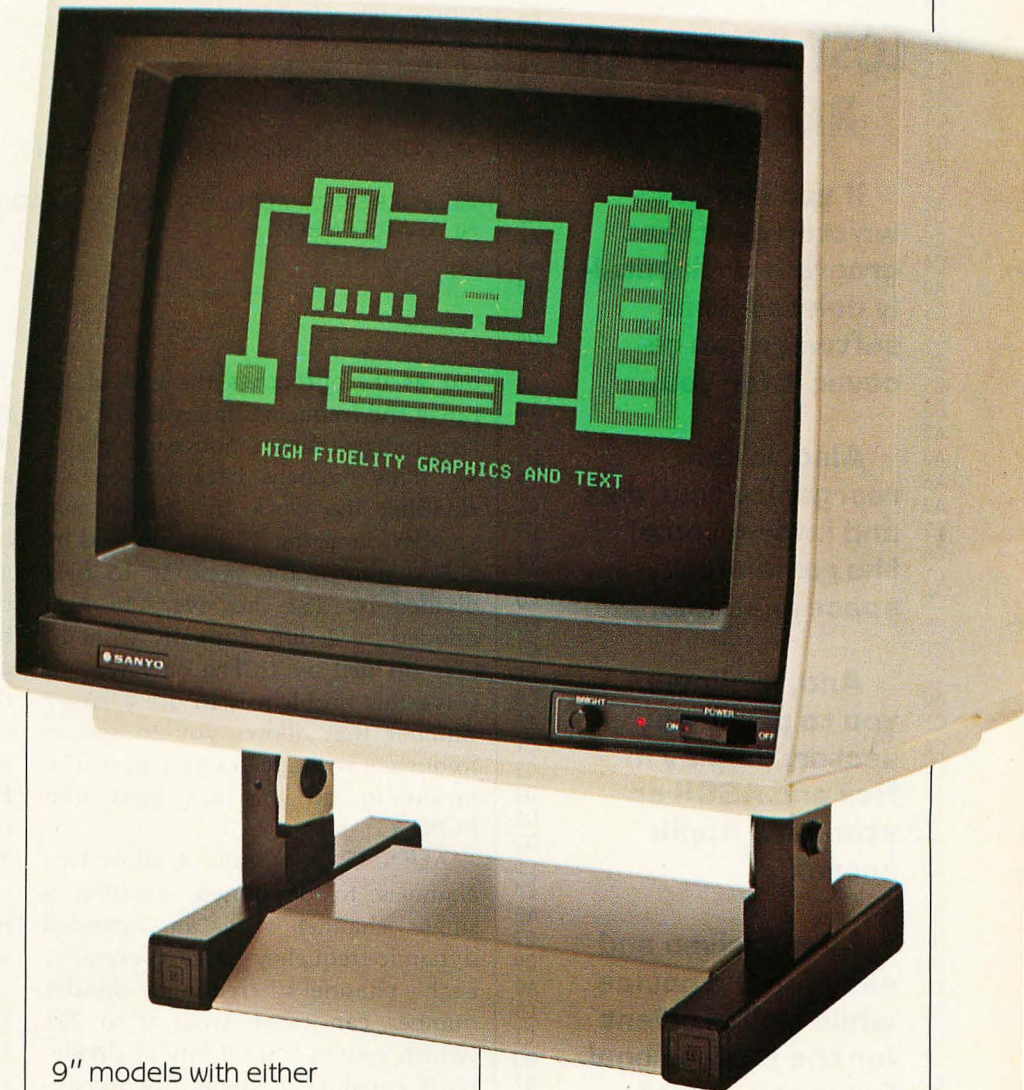
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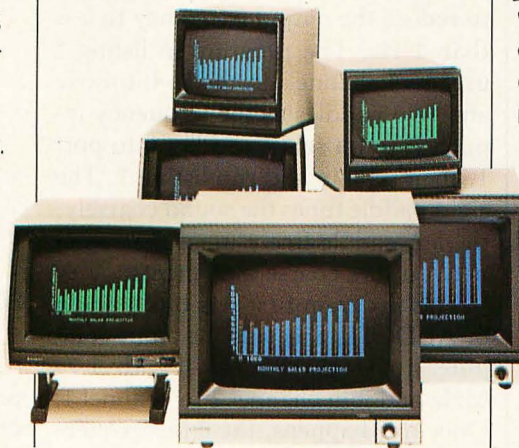


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**Listing 1:** A program that uses a 16-bit divide-by-N register. When used with game paddles in port 1, this program produces a sound with a frequency that can be varied by paddles 1 and 2. Paddle 1 changes the sound in large steps; paddle 2 changes the sound between two adjacent large steps.

10	SOUND 0,0,0,0; REM	Initialize sound
20	POKE 53768,80; REM	Clock channel 1 with 1.79 MHz, clock channel 2 with channel 1
30	POKE 53761,160;POKE 53763, 168; REM	Turn off channel 1, turn on channel 2 (pure tones)
40	POKE 53760,PADDLE(0);POKE 53762,PADDLE(1)	
50	GOTO 40; REM	Set paddles to put frequencies in frequency registers

but as it approaches the end of its range the frequency takes larger and larger steps that are noticeably clumsy. This happens because you are dividing the clock by smaller and smaller numbers: 15 kHz divided by 255 is almost the same as 15 kHz divided by 254; however, 15 kHz divided by 2 differs greatly from 15 kHz divided by 1. The only way to solve this problem is to use a larger number that allows you to specify frequency with greater precision. The means to do this are built into POKEY.

AUDCTL bits 3 and 4 allow two channels to be joined, creating a single channel with an extended dynamic-frequency range. Normally, each channel's frequency-divider number can range from 0 to 255 (which results from 8 bits of divide-by-N capability). Joining two channels allows a frequency range of 0 to 65535 (16 bits of divide-by-N capability). In this mode, it is possible to reduce the output frequency to less than 1 Hz. The program in listing 1 uses two channels in the 16-bit mode and two paddles as the frequency inputs. Insert a set of paddles into port 1, then type in and run listing 1. The right paddle tunes the sound coarsely; the left paddle finely tunes the sound between the coarse increments.

This program first sets bits 4 and 6 of AUDCTL; this tells the Atari computer to clock channel 1 with 1.79 MHz and join channel 2 to channel 1. Once this happens, the 8-bit frequency registers of both channels are assumed to represent a single 16-bit number N that is used to divide the input clock. Next, the volume of

channel 1 is set to 0. Since channel 1 no longer has its own direct output, its volume setting is meaningless to us and we zero it. The channel 1 frequency register is used as the fine-tuning or low byte in the sound generation; the channel 2 frequency register is the coarse-tuning or high byte. For example, poking a 1 into the channel 1 frequency register makes the pair of registers divide by 1. Poking a 1 into the channel 2 frequency register makes the pair divide by 256. Poking a 1 into both frequency registers makes the pair divide by 257.

Bit 3 of AUDCTL can be used to join channel 4 to channel 3 in the same way.

The following instructions demonstrate some interesting aspects of 16-bit sound (try poking other numbers into the last four locations):

```
SOUND 0,0,0,0
POKE 53768,24
POKE 53761,168
POKE 53763,168
POKE 53765,168
POKE 53767,168
POKE 53760,240
POKE 53764,252
POKE 53762,28
POKE 53766,49
```

## High-Pass Filters

AUDCTL bits 1 and 2 control high-pass filters in channels 2 and 1, respectively. A high-pass filter allows only higher frequencies to pass through. In the case of these high-pass filters, high frequencies are defined as anything higher than the output of another channel selected by



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the AUDCTL bit combination. For example, if channel 3 is playing a cow's moo and AUDCTL bit 2 is set, only sounds with frequencies higher than the moo will be heard on channel 1 (anything lower than the "moooo" will be filtered out). See figure 6.

The filter is programmable in real time because the filtering channel can be changed on the fly. This opens a large field of possibilities to the pro-

grammer. The filters are generally used to create special effects. Try the following statements:

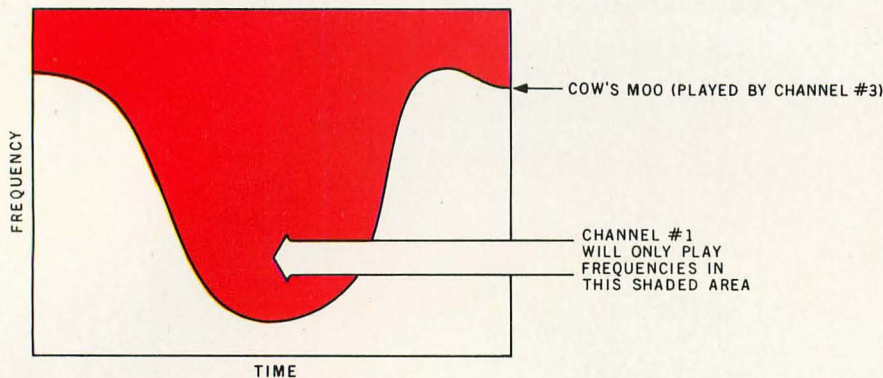
```
SOUND 0,0,0,0
POKE 53768,4
POKE 53761,168:POKE 53765,168
POKE 53760,254:POKE 53764,127
```

### 9-Bit Polynomial Conversion

Bit 7 of AUDCTL, when set, turns the 17-bit poly counter into a 9-bit

poly counter. The shorter the poly counter, the more often its distortion pattern repeats, or the more discernible is the pattern in the distortion. Therefore, changing the 17-bit poly counter into a 9-bit poly counter makes the noise pattern more repetitious and more discernible. Try the following demonstration of the 9-bit poly-counter option, listening carefully when the POKE is executed:

```
SOUND 0,80,8,8
POKE 53768,128
```



**Figure 6:** High-pass filtering in the Atari 400/800. At any given instant, the only frequencies in channel 1 that are passed by the filter are those greater than the frequency being played in channel 3.

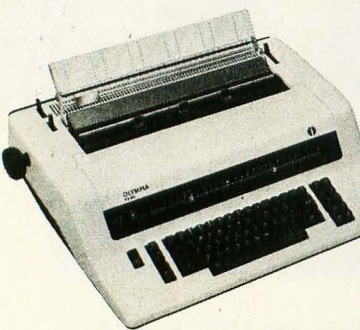
The first statement activates the 17-bit poly counter; the second changes the counter to a 9-bit poly counter.

### Next Month

Now that we know about the various registers that control the sound-generating capabilities of the Atari 400/800, we will look at several BASIC and machine-language techniques to use sound within a program. ■

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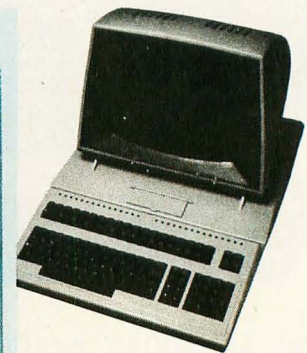
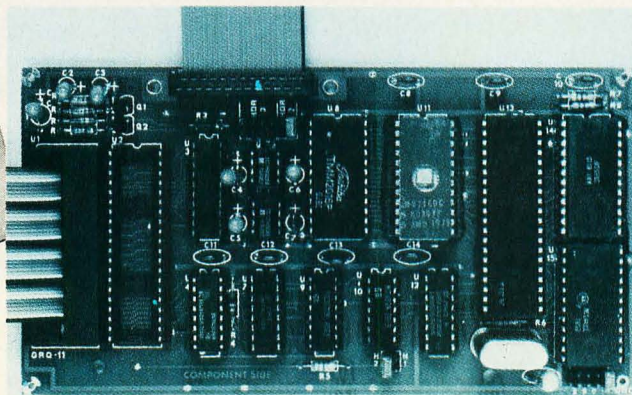
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# Build a Half-year Clock for the Color Computer

## Fourth in a Series

William Barden Jr.  
28122 Orsola  
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The ideal clock for a computer system, to my mind, would be an inexpensive, compact, accurate unit with a self-contained power supply that could be easily interfaced to the computer system. This article describes a clock for the Radio Shack Color Computer; it meets all of my goals at the expense of some software complexity.

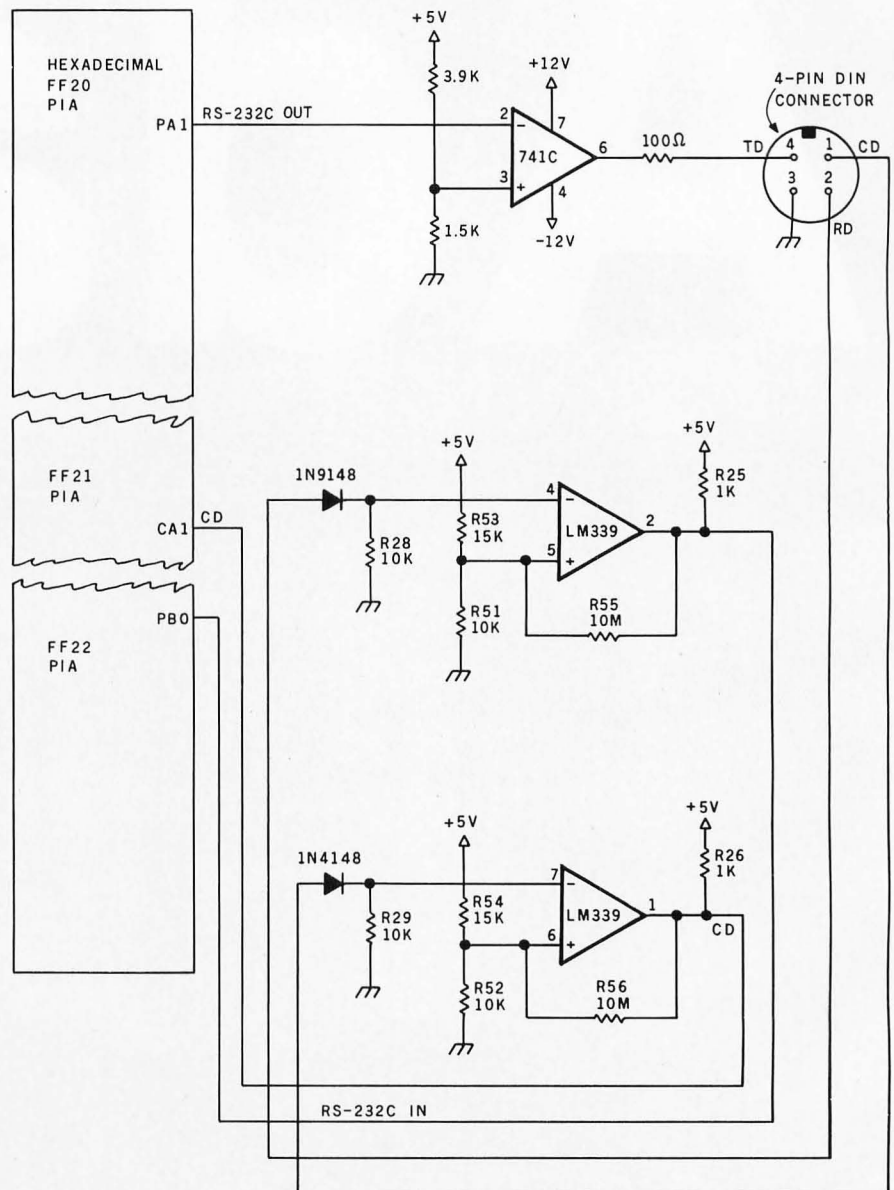
The half-year clock (HYC) described here can provide the time with a resolution of  $\pm 10$  seconds or better over a six-month period. Powered by a self-contained 9-volt (V) battery, it can be disconnected from the Color Computer at any time, set aside, plugged in later, and will continue reporting the time. It is a compact unit measuring 14 by 9 by 3.8 cm (5½ by 3½ by 1½ inches).

The HYC uses seven integrated circuits (ICs) plus some discrete components. The project is built using wire-wrapping techniques. If you've never tried wire-wrapping, fear not: I'll provide detailed tips for easy construction.

Since the HYC communicates with the Color Computer via the serial interface of the computer, I'll start with a description of that interface.

### Color Computer Serial Interface

The complete serial interface of the Color Computer is shown in figure 1. The four lines of the serial interface go to a 4-pin DIN plug on the rear of the system. These four lines are a subset of the 25 lines normally used in other computer systems, such as the Radio Shack Models I and III. The Color Computer uses *asynchronous*



**Figure 1:** The Color Computer RS-232C interface consists of two comparators and one op amp used as a comparator. The TD signal is generated from software by output to PIA (peripheral interface adapter) address FF20 hexadecimal. The RD is read into PIA address FF22 hexadecimal. The CD signal is not normally used and is an "edge trigger" signal generating a PIA interrupt.



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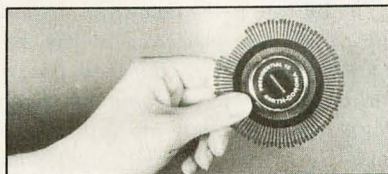
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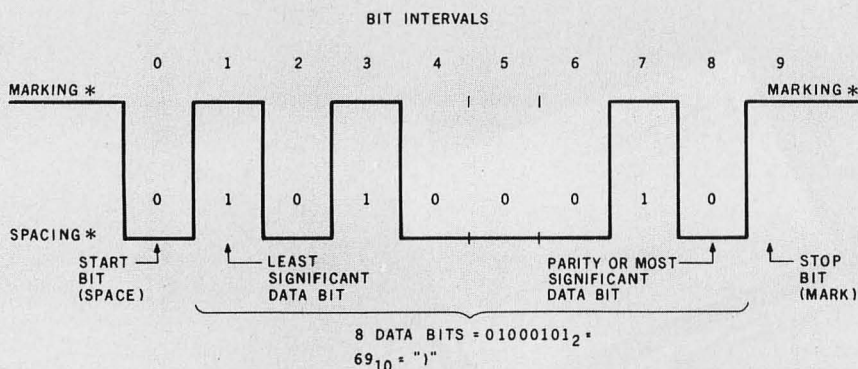
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Data sent in asynchronous RS-232C format typically consist of a start bit, 8 bits of data, and one or two stop bits. The bits are evenly spaced with no inherent clock.



\* ON RS-232C LINES REVERSE LOGIC (MARKING IS -12V, SPACING IS +12V)

## Asynchronous Communication

The EIA standard RS-232C defines the format for data communication. Therefore, serial communication is often called "RS-232C" or "RS-232" communication. A system channel designed for data communication is known as a serial or RS-232 port.

The standard format for asynchronous communication is shown above. In this example, 8 bits make up the actual data word. The data are asynchronous, that is, they are sent at unpredictable times, rather than at regularly spaced intervals. A good example of an asynchronous datum is a character transmitted from a keyboard to a communications system such as The Source or Compuserve. The host system does not know when to expect the next character—it may occur within 1/10 second or 10 seconds. Each character must be detected and handled as an independent "event."

The computer system or device receiving an asynchronous character can read either a logic 1 or logic 0 on the receive data (RD) line. Initially, the RD line is at logical 1, called "mark." The receiving system or device expects this high condition to exist initially. To signal the start of a data word, the transmitting system sends a start bit by bringing the RD line to a logical 0,

called a "space," for a duration known as a "bit time." The length of the bit time depends on the data-transmission rate and may vary from about 9 milliseconds to 0.1 millisecond.

The receiving system or device detects the start bit, delays 1/2 bit time, and gets set to receive the rest of the data word at evenly spaced intervals of one bit time. The start bit is followed by eight data bits (one of which may be a parity bit) and one or two stop bits that are always at logic 1 (mark). The stop bits ensure that the RD line will be marking prior to transmission of the next data word.

The bit rate is the data-transmission rate of all data measured in bits per second (bps). Three hundred bps is typical for the Color Computer. Each character at this bit rate typically is made up of one start bit, eight data bits, and one stop bit, for a total of 10 bits. Thus, 300 bps yields 30 characters per second. The bit time is 1/300 second, or 3.33 milliseconds.

The standard logic levels for RS-232C communication are voltages above 3 V (logic 0) and below -3 V (logic 1). In the Color Computer, the voltages used are 12 V for logic 0 and -12 V for logic 1.

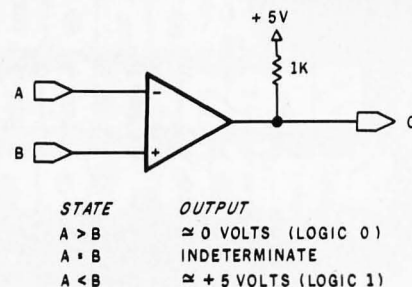


Figure 2: A comparator contrasts two input signals in relation to each other. If the "+" (plus) input is greater than the "-" (minus) input, a logical 1 is generated at the output; if the "+" input is less than the "-" input, a logical 0 is produced.

serial communication, which requires only three lines; the fourth line is available for special purposes. See the text box for background information on serial communication.

**Interface operation.** The Color Computer's serial interface is made up of one comparator (actually an operational amplifier) for controlling the transmit data (TD) line and two comparators for checking the receive data (RD) and carrier detect (CD) lines.

A comparator accepts two input voltages. If the "+" (plus) input voltage is higher than the "-" (minus) input, the comparator outputs a logic 1; if the "+" input voltage is lower than the "-" input, the comparator outputs a logic 0 (see figure 2).

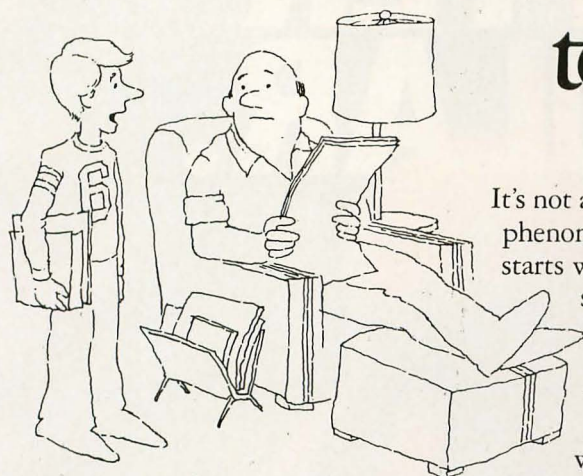
In the following descriptions, I'll be referring to a few "memory" addresses in the Color Computer that function as I/O lines—part of the peripheral interface adapter (PIA).

**TD line.** The 741C operational amplifier compares the "-" input from bit 1 of port address FF20 hexadecimal with the "+" input from the voltage divider R23/R24. The "+" input is a constant +1.38 V. A logic 1 on port FF20 hexadecimal bit 1 will generate -12 V on the TD line; a logic 0 will generate +12 V on the TD line.

**RD and CD lines.** The two LM339 comparators have serial data as their input. Both have the same configuration. One is connected to the RS232IN line of port FF22 hexadecimal bit 0. The second is con-



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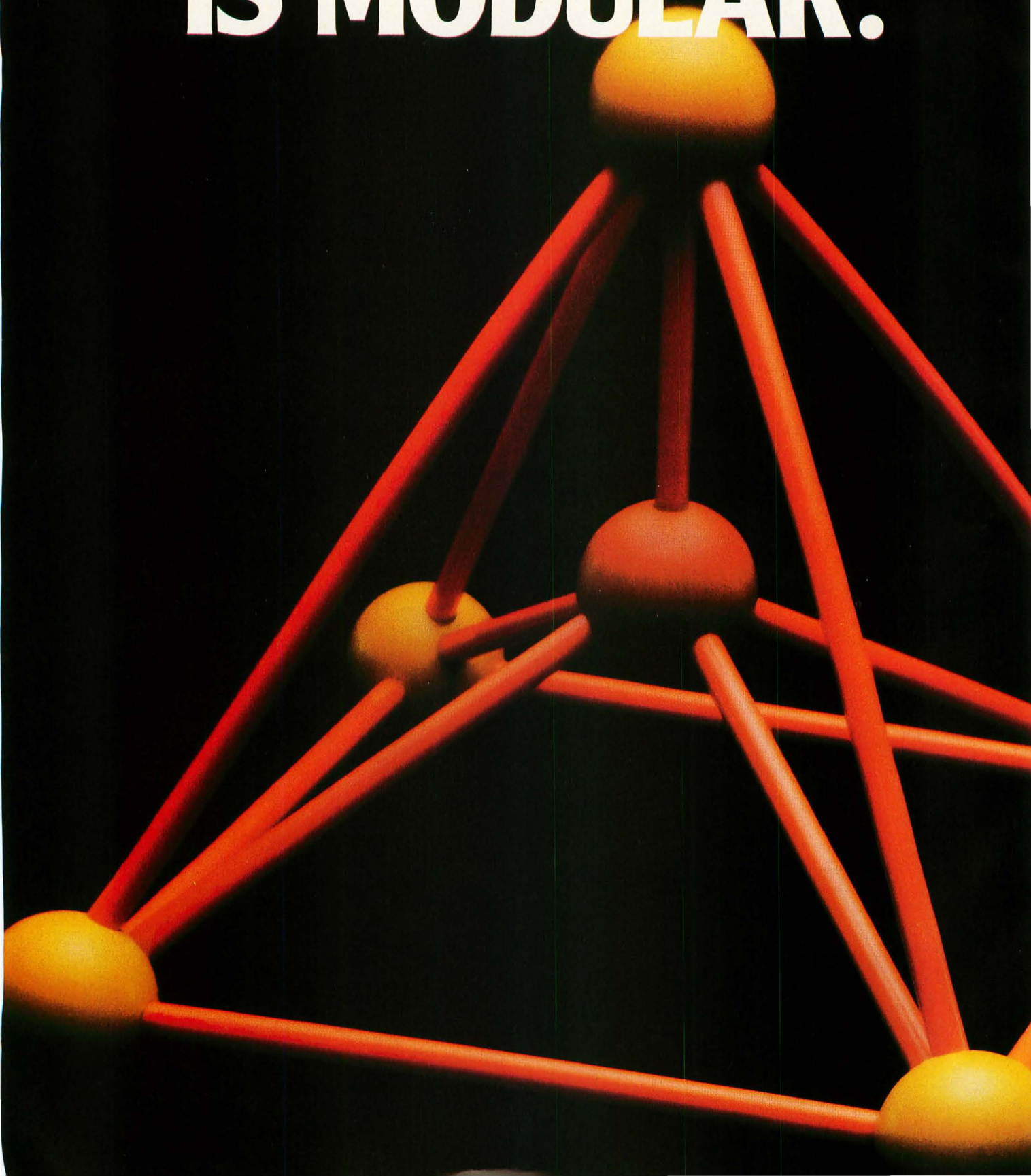
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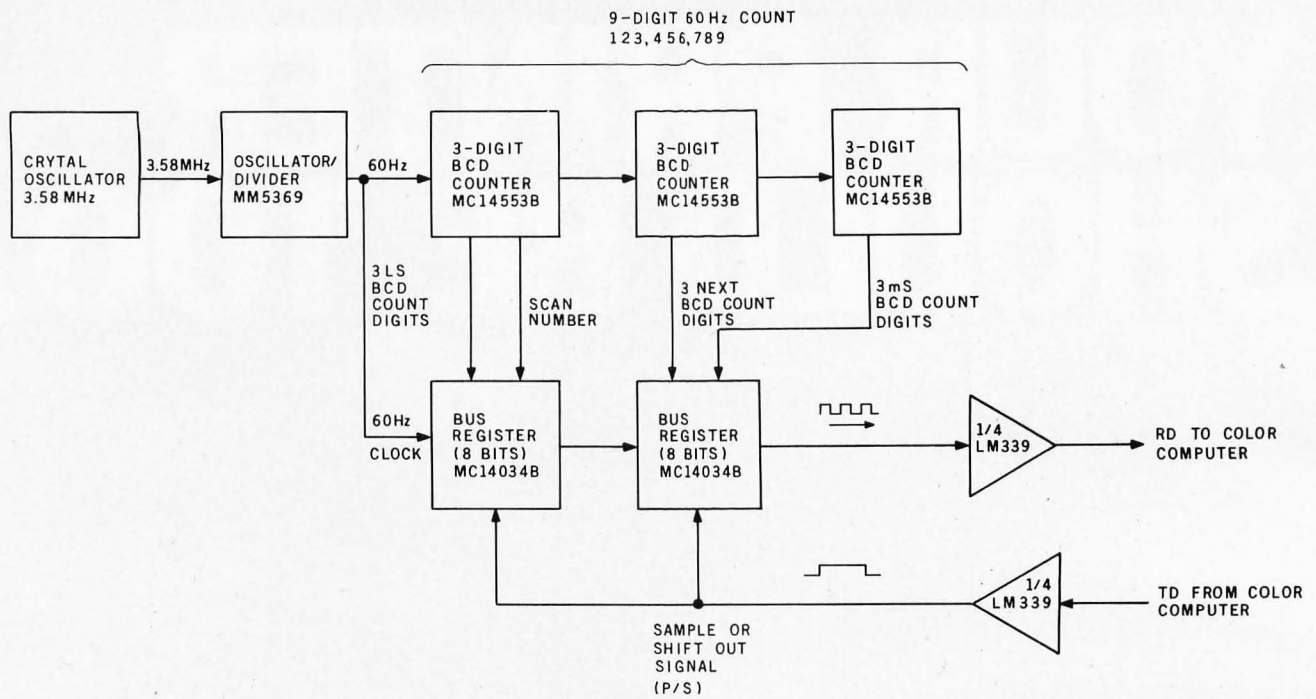
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**Figure 3:** The half-year clock consists of a crystal oscillator, a divider producing 60-Hz pulses, a 9-digit BCD counter, a parallel/serial register, and comparator output to the Color Computer.

connected to the CD line of port FF21 hexadecimal. The CD line generates an interrupt and is not used in this project.

The "+" input of the RS232IN comparator is biased at +2 V by the R54/R52 voltage divider. The "-" input is connected via a diode to the RD line. If the RD line is at 2.6 V (+2-V bias plus about 0.6 V for the diode), the output of the comparator is a logic 0, or about 0 V. If the RD line is less than 2.6 V, the diode will not conduct, and the output of the comparator is a logic 1, or about +5 V. In short, the RS232IN signal follows the serial data on the RD line and can be tested by reading FF22 hexadecimal bit 0.

The third line used in serial communication is ground, which is connected to pin 3 of the DIN connector.

### HYC Design

A block diagram of the HYC is shown in figure 3. It interfaces to the Color Computer via the RD, TD, and ground lines of the serial port. The clock count is sent via the RD line after a prompt by the Color Computer from the TD line.

At the heart of the HYC are three BCD (binary-coded decimal) counter

chips. Each chip accumulates a three-decimal digit count of 0 to 999. Together, the three chips accumulate a count of up to 999,999,999.

The input to the three counters is a 60-hertz (Hz) signal from the oscillator/divider chip. This chip takes a 3.58-megahertz (MHz) signal from a "color burst" crystal and divides it down to 60-Hz signals.

At any given time, the count in the counter chips represents the number of 60-Hz pulses received. The maximum count of 999,999,999 represents 16,666,666 seconds—about 192 days.

The two "universal bus register" chips load 16 bits from the counters upon command from the Color Computer. The bits are then shifted out to the RD line at a rate of one every  $\frac{1}{60}$  second. It requires three transfers (48 bits total) to transmit the current time to the Color Computer. (Of course, the Color Computer has to decode it into a usable form.) The detailed logic diagram of the HYC is shown in figure 4.

**Counters.** The counters are Motorola MC14553B ICs. Each chip increments its count by one each time a 60-Hz pulse is received from the CLK input. To output its count, each

chip presents one digit at a time over the Q3 through Q0 outputs. Q3 through Q0 represent a BCD digit of 0000 through 1001. For example, if the count in one of the MC14553B chips was "678," the outputs on Q3 through Q0 would be, in sequence, 0110, 0111, and 1000.

The chips are outputting their counts continually. The *scan rate*, the rate at which the three digits appear, is controlled by an external capacitor connected to C1A and C1B. A 1.0-microfarad ( $\mu$ F) capacitor generates a scan rate of about 3 Hz, or a new BCD digit every 333 milliseconds (ms). The scan frequency has no relation to the 60-Hz clock frequency. This scan frequency is applied to all three counters simultaneously so that the BCD digits of all sets of Q3 through Q0 change at the same time.

The DS3 to DS1 outputs indicate which BCD digit is being displayed on the Q3 through Q0 outputs. If DS3=0, the most significant digit is being output; if DS2=0, the next digit is being output; and if DS1=0, the least significant digit is being output.

To read the current count requires three reads of Q3 through Q0: at DS1 time, DS2 time, and DS3 time. When



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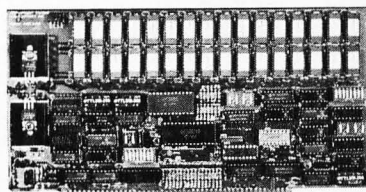
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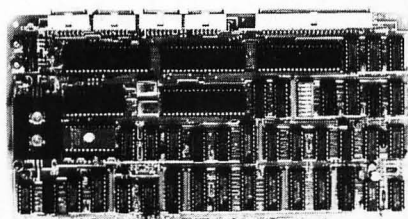
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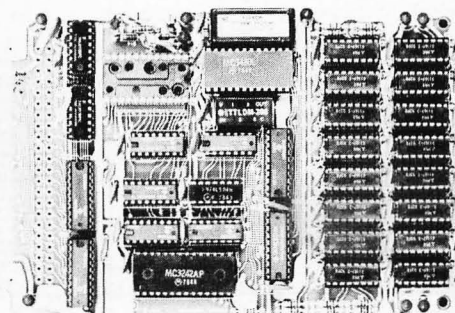
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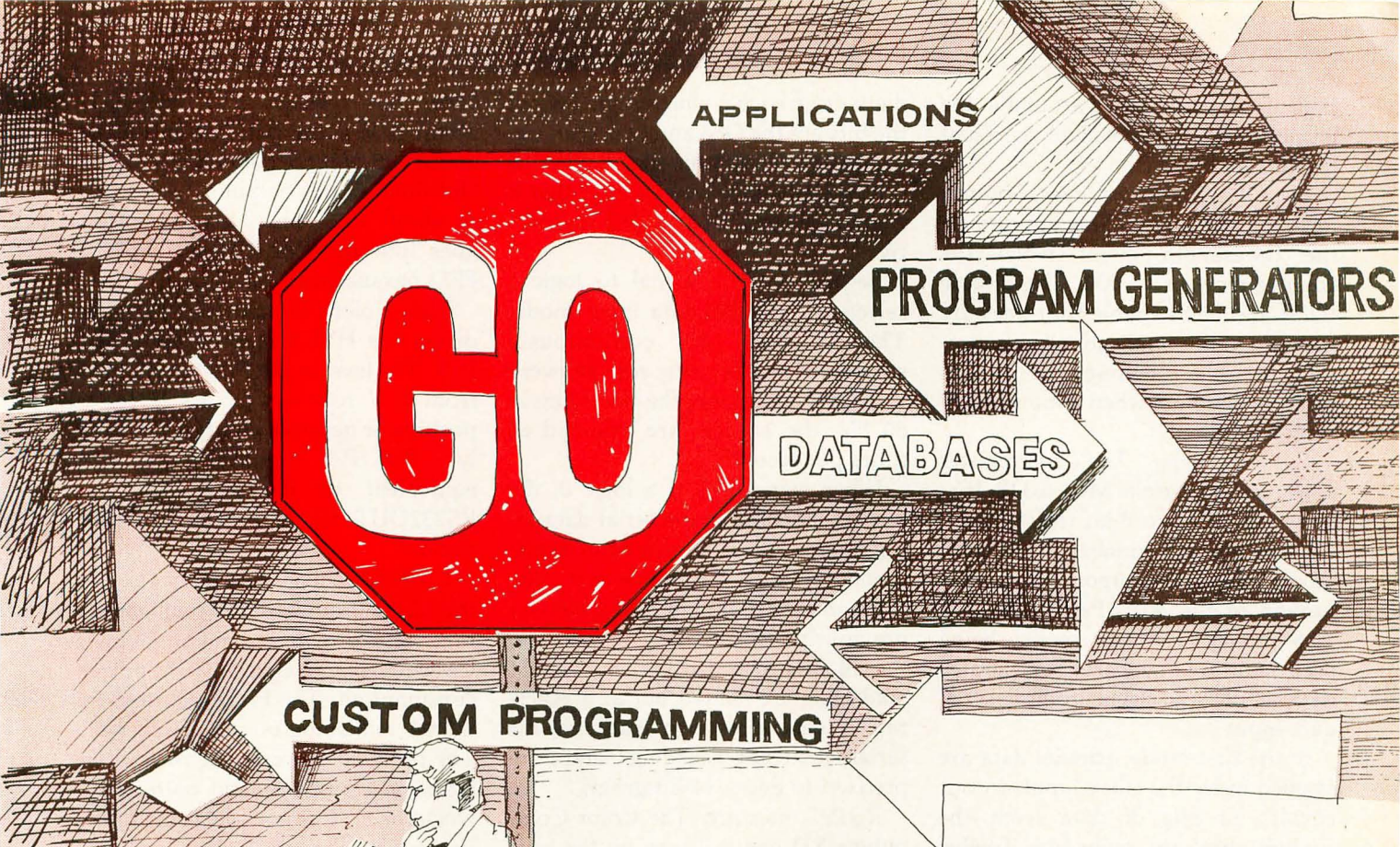
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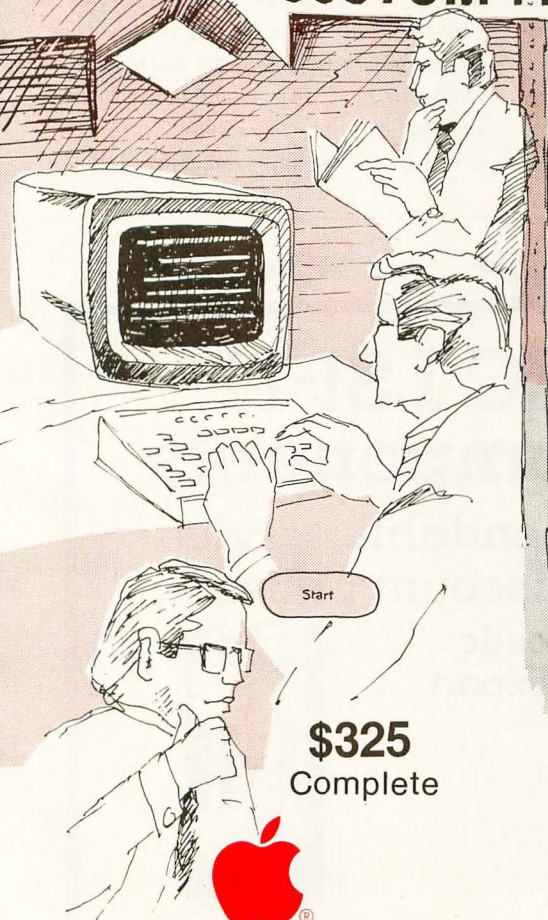
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*RS-232 interface.* The Color Computer's RD line is driven by the least significant bit of the HYC's lower-

*CMOS circuitry.* All chips except the LM339s are CMOS (complementary metal-oxide semiconductor). CMOS is characterized by low power consumption. The HYC requires less than 4 milliamperes (mA) of current. The optional power switch shown in figure 4 lets you extend battery life when the HYC is not connected to the system or when the Color Computer is not in use. It shuts off power to all

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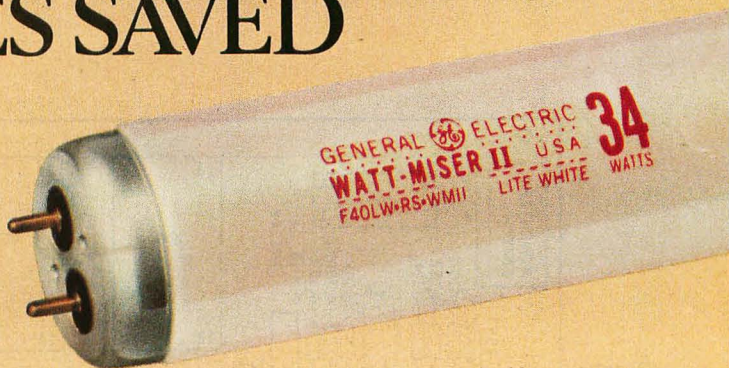
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IC1 Motorola MM5369 oscillator/divider  
IC2-IC3 Motorola BCD counter  
IC5 LM339 comparator  
IC6-IC7 Motorola MC14034B universal bus register\*

1 1 K $\Omega$ , 1/4 W, 10%  
4 10 K $\Omega$ , 1/4 W, 10%  
2 15 K $\Omega$ , 1/4 W, 10%  
1 100 K $\Omega$ , 1/4 W, 10%  
1 20 M $\Omega$  (use two 10 M $\Omega$ ), 1/4 W, 10%

**Capacitors**  
 1 4.7-pF disk  
 1 47-pF disk  
 2 1.0- $\mu$ F electrolytic, 25 V

- 1 3.58-MHz crystal
- 1 SPDT momentary switch, miniature
- 1 SPST or SPDT switch, miniature (optional)
- 1 1N4000 series diode (not critical)
- 1 4-pin male DIN connector\*
- 1 9-V battery, alkaline
- 1 8-pin wire-wrap socket
- 1 14-pin wire-wrap socket
- 3 16-pin wire-wrap sockets
- 2 24-pin wire-wrap sockets\*
- 1 prototype board
- 1 case
- 1 ribbon cable, 3- or 4-conductor wire-wrap wire, solder, #14 wire, battery connectors

Diagram illustrating the bottom view of the circuit board, showing components, buses, and dimensions.

**Components and Connections:**

- IC5:** A 5-pin component (pins 8, 7, 14, 1, 1) connected to the GROUND BUS and VDD BUS.
- IC6:** A 24-pin component (pins 24, 1, 13, 12).
- IC7:** A 24-pin component (pins 24, 1, 13, 12).
- IC1:** A 5-pin component (pins 5, 4, 8, 1, 1) connected to the GROUND BUS and VDD BUS.
- IC2:** A 16-pin component (pins 16, 1, 9, 8).
- IC3:** A 16-pin component (pins 16, 1, 9, 8).
- IC4:** A 16-pin component (pins 16, 1, 9, 8).
- MOMENTARY SWITCH:** Connected to the GROUND BUS and VDD BUS.
- CRYSTAL:** Connected to the GROUND BUS and VDD BUS.
- Resistors:** 10K, 15K, 100K, 10K, 10K, 10K, 1K, 10M, 10M.
- Capacitors:** 1μF, 47pF, 47pF.
- Diode:** 1N4148.

**Buses:**

- GROUND BUS:** Connected to the MOMENTARY SWITCH, CRYSTAL, and various components.
- VDD BUS:** Connected to the MOMENTARY SWITCH, CRYSTAL, and various components.

**Dimensions:**

- 30 COLUMNS:** Indicated by a bracket at the bottom.
- 25 ROWS:** Indicated by a bracket on the right side.

**CONNECTING WIRE:** Indicated by a symbol at the bottom right.

**(BOTTOM VIEW)**

components not involved in maintaining the half-year count.

A typical alkaline battery has a capacity of about 0.5 ampere-hours, making the HYC functional for about 250 hours of continuous use in the low-power mode, or about 125 hours of continuous use without the optional power switch. This 5/10-day life can be extended by paralleling a number of 9-V batteries or by using a larger battery, such as the NEDA 1603 size, which will not fit in the case used here, but which will last a good deal longer—over 1000 hours in the low-power mode.

CMOS operates on a power supply of from 3 to 18 V. The voltage of the supply can be degraded quite far before the HYC will stop operating. The limiting factor is the RD output, which must swing from 0 to at least +2.6 V for proper comparator operation in the Color Computer.

All the parts in the HYC are easy to obtain. The 3.58-MHz crystal, oscillator/divider, counter chips, and LM339 are stocked by Radio Shack. The bus-register chips are available from any well-stocked parts supplier (see the ads in any issue of BYTE). The cost of all parts should be under \$20. See the parts list in table 1.

The HYC is housed in a project case (Radio Shack 270-219 or equivalent). This plastic case has a built-in compartment large enough to hold a 9-V battery.

A 7- by 9.5-cm (2¾- by 3¾-inch) grid board is used to hold the components. Two #14 bus wires run down the center of the board. One is used for the  $V_{DD}$  bus (+9 V); the other is ground (see figure 5).

The board has printed-circuit pads on one side. Mount the IC sockets, resistors, capacitors, and crystal on the side of the board without the foil. Solder two diagonally opposing pins of the IC sockets. Leave the resistor, capacitor, and crystal leads uncut for wire-wrapping.

Wire-wrap the IC pins according to table 2. All detailed connections are shown, but obvious power-supply connections are not indicated. I



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recommend buying precut wire in lengths of 1, 2, and 3 inches. It is inexpensive and will cut the wire-wrap time in half.

The  $V_{DD}$  and ground leads can be connected directly to the two buses. No power switch is used. The three leads to the serial port can be made from three-conductor ribbon cable routed into the battery compartment of the case and between the compartment cover (see figure 6). The opposite end of the ribbon cable con-

nects to the 4-pin male DIN plug (see figure 7).

### Testing the Hardware

After you've assembled the board, test the interconnections, referring to table 2 and figure 4. Invariably, there will be one or two miswires. (I once wired 10 chips in mirror-image fashion—pin 1 to 24, 2 to 23, etc.; you should be in better shape than this!)

Use two common straight pins, clip

leads, and an ohmmeter or continuity tester to check all connections before installing the ICs in their sockets. When you're confident that all the connections are proper, plug in the ICs. CMOS is not as intolerant of static electricity as it once was, but avoid handling the chips more than necessary.

Plug in the 9-V battery, and you should be in operation. If you have an oscilloscope, check between pin 3 of IC4 and ground. The scan clock

MM5369 (IC1)	IC4-13 to IC3-13
IC1-1 to IC2-12	IC4-16 to $V_{DD}$
IC1-2 to GND	
IC1-5 to 20 M $\Omega$ /XTAL	LM339 (IC5)
IC1-6 to 20 M $\Omega$ /1 k $\Omega$	IC5-1 to 100 k $\Omega$
IC1-8 to $V_{DD}$	IC5-1 to IC6-13
	IC5-2 to GND
Oscillator	IC5-3 to $V_{DD}$
20 M $\Omega$ /IC1-6 to 1 k $\Omega$	IC5-4 to IC5-2
20 M $\Omega$ /IC1-5 to XTAL	IC5-5 to IC5-2
MC14553B (IC2)	IC5-6 to 10 k $\Omega$ /diode (-)
IC2-1 to IC6-3	IC5-7 to 10 k $\Omega$ /15 k $\Omega$
IC2-3 to 0.47 $\mu$ F	IC5-8 to IC7-23
IC2-4 to 0.47 $\mu$ F	IC5-9 to 10 k $\Omega$ /15 k $\Omega$
IC2-5 to IC6-8	IC5-10 to IC5-13
IC2-6 to IC6-7	IC5-11 to IC5-13
IC2-7 to IC6-6	IC5-12 to GND
IC2-8 to GND	IC5-13 to GND
IC2-9 to IC6-5	IC5-14 to 10 k $\Omega$ /TD
IC2-10 to IC2-11	
IC2-11 to IC2-8	RS-232 Cable
IC2-12 to IC6-15	Diode (+) to RD
IC2-13 to SPDT center	TD to 10 k $\Omega$ /IC5-14
or to IC2-11	GND to GND
IC2-14 to IC3-12	MC14034B (IC6)
IC2-15 to IC6-4	IC6-9 to IC6-24
IC2-16 to $V_{DD}$	IC6-10 to IC6-11
MC14553B (IC3)	IC6-11 to IC6-12
IC3-4 to IC2-3	IC6-12 to GND
IC3-5 to IC6-2	IC6-13 to IC7-13
IC3-6 to IC6-1	IC6-14 to IC6-24
IC3-7 to IC7-8	IC6-23 to IC7-10
IC3-8 to GND	IC6-24 to $V_{DD}$
IC3-9 to IC7-7	
IC3-10 to IC2-10	MC14034B (IC7)
IC3-11 to IC3-8	IC7-1 to IC7-11
IC3-13 to IC2-13	IC7-2 to IC7-9
IC3-14 to IC4-12	IC7-9 to IC7-24
IC3-16 to IC2-16	IC7-11 to IC7-12
	IC7-12 to GND
MC14553B (IC4)	IC7-14 to IC7-24
IC4-4 to IC3-4	IC7-15 to IC6-15
IC4-5 to IC7-6	IC7-24 to $V_{DD}$
IC4-6 to IC7-5	
IC4-7 to IC7-4	Miscellaneous
IC4-8 to GND	SPDT-NC to GND
IC4-9 to IC7-3	SPDT-NO to $V_{DD}$
IC4-10 to IC3-10	GND bus to GND
IC4-11 to IC4-8	$V_{DD}$ bus to +9 V

Table 2: Major component pin connections.

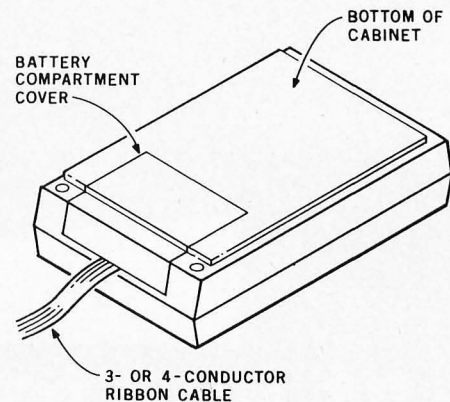


Figure 6: The ribbon cable can be brought out between the cover of the battery compartment and the project case.

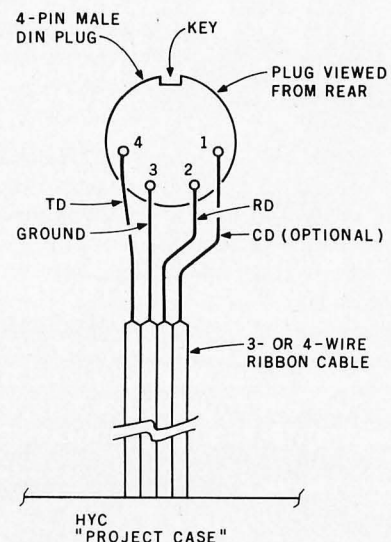
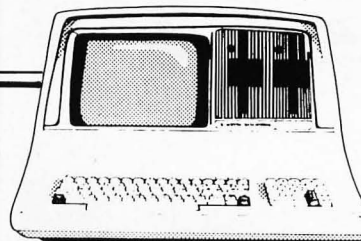
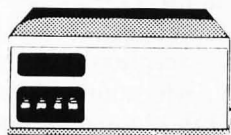


Figure 7: A 4-pin male DIN connector is used to link the half-year clock to the Color Computer's RS-232C jack on the rear of the computer.



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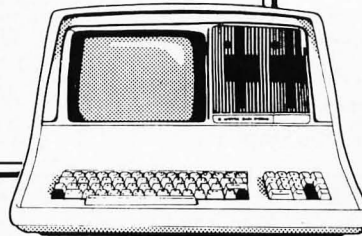
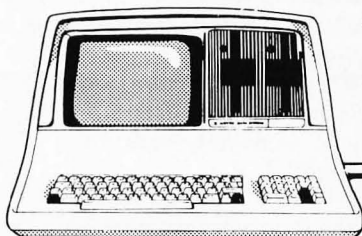
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should be operating at about 3 Hz. If it's slower than 3 Hz, try lower values than the 1-μF capacitor connected between pins 3 and 4 of IC2. Also, check the oscillator/divider output. You should see a clean 60-Hz square wave.

### HYC Software

The HYC, in keeping with the traditions of the Color Computer system, is largely software dependent. Listing 1 shows a 6809

assembly-language program that reads data from the HYC. It resides in the upper 256 bytes of RAM (in a 16K Color Computer system). Protect this area by a CLEAR 200,&H3EFF when running the program with BASIC. Key in the 97 bytes of the program or use POKes and DATA statements in your BASIC program.

With the exception of 2 bytes, the program is relocatable. Change the second and third bytes of the second instruction (locations 3F05 to 3F06 hexadecimal in listing 1) if you

### How the HYC Program Works

The Clock I/O Handler (listing 1) is divided into three parts: the DELAY subroutine, the INPUT subroutine, and the main loop CLOCK.

The DELAY subroutine delays in multiples of 0.8333 second. One 60-Hz pulse has a duration of 16.666 milliseconds. This subroutine can be conveniently used for delaying in multiples or submultiples of one 60-Hz bit time.

The INPUT subroutine makes a single read of 16 bits of data from the counters. The BSR instruction at INPUT calls INPUA, resulting in the code from INPUA through the RTS instruction being executed twice. Eight bits of data are read on each pass through the section of code.

The loop at INP010 reads in eight data bits from port FF22 hexadecimal. Bit 0 is shifted right into the carry condition code and then rotated into the byte pointed to by the user stack pointer. The byte is initially cleared to 0. At the end of the second pass through INPUA, 2 bytes of data have been stored in the user stack, representing one complete read of three digits.

The main loop at CLOCK performs consecutive calls of the INPUT subroutine until three samplings of DS1, DS2, and DS3 have been compiled in the 6 bytes of the buffer. First, a 1 is output to bit 1 of port FF20 hexadecimal, bringing the HYC's P/S signal to a 1 (parallel data input mode). A delay of 1.9 cycles is provided so that

the data can be clocked into the bus registers.

After the delay, the serial output is started by outputting a 0 to bit 1 of port FF20 hexadecimal, bringing P/S to a 0 (serial data input mode). Immediately after the output, the serial datum is checked by reading port FF22 hexadecimal bit 0. If the datum is a 1, the first clock occurred too close to the initialization of the process, and the process is repeated from CLK010. If the datum is a 0, a delay of 1/10 cycle is done and a test for 0 is done again; if the datum is not 0, the clock occurred within 1/10 cycle (close to the edge of a bit time), so the process is repeated.

If the first bit is a 0, the loop at CLK020 delays until the appearance of a 1. At this point, the second clock has just occurred. A delay of 1½ cycles is then done to position the next read in the middle of the third data bit time. The INPUT subroutine is then called to read in the next 16 bits. The last two of these are always zeros.

Now, the scan number of the first 16 bits is tested. If not equal to binary 11, or DS1, the process is repeated from CLK010. If equal to DS1, the user stack pointer is adjusted, the scan number is adjusted to 2, and another read from CLK010 is done to read the DS2 cycle. A third iteration reads the last cycle, DS3.

The short subroutine at GETSER gets the serial bit and tests it, changing the Z condition code to zero or nonzero.



relocate the program. These 2 bytes should hold the address of a 6-byte buffer.

A simple BASIC test program is shown in listing 2. This program defines the location of the program by the DEFUSR0 statement. (Change this statement if you have relocated the machine-language code.) The assembly-language program is entered by the USR0 call and returns with 6 bytes of the current clock count in locations 3FF0 through 3FF5 hexadecimal. These six locations rep-

resent the BCD digits and scan numbers as shown in figure 8. Sample outputs are shown in figure 9.

Text continued on page 122

**Listing 2:** This short BASIC program calls the clock I/O handler and displays the 6 bytes of data that were read.

```
100 DEFUSR0=&H3F00
110 A=USR0(0)
120 FOR I=&H3FF0 TO &H3FF5
130 PRINT PEEK(I),
140 NEXT I
150 PRINT:PRINT:GOTO 110
```

**Listing 1:** The clock I/O handler is a three-section, assembly-language program that reads in 6 bytes of the count into a buffer at location 3FF0 hexadecimal.

```
3F00          00100      ORG      $3F00
              3FF0      00110  BUFFER EQU  $3FF0
00120  *****
00130  * CLOCK I/O HANDLER. READS IN 3 CLOCK COUNTS *
00140  *****
00150  CLOCK LDY      #3      SCAN #
00160          LDU      #BUFFER
00170  CLK010 LDA      #2      2 TO A
00180          STA      $FF20   STROBE IN NEXT COUNT
00190          LDA      #36     1.9 CYCLE COUNT
00200          BSR      DELAY   DELAY 1.9 60HZ CYCLES
00210          STA      $FF20   START SERIAL
00220          BSR      GETSER  GET SERIAL IN
00230          BNE      CLK010  GO IF INVALID
00240          LDA      #2      DELAY COUNT
00250          BSR      DELAY   DELAY 1/10 CYCLE
00260          BSR      GETSER  GET SERIAL IN BIT
00270          BNE      CLK010  GO IF INVALID
00280  CLK020 BSR      GETSER  GET SERIAL IN BIT
00290          BEQ      CLK020  GO IF 0
00300          LDA      #30     1+1/2 CYCLE COUNT
00310          BSR      DELAY   DELAY 1+1/2 CYCLE
00320          BSR      INPUT  READ CLOCK COUNT
00330          LEAU     -2,U     RESET PNTR
00340          TFR      Y,D     SCN # NOW IN B
00350          EORB     1,U     TEST SCN #
00360          ANDB     #3      MASK OUT DIGIT
00370          BNE      CLK010  GO IF NOT PROPER SCN #
00380          LEAU     2,U     POINT TO NEXT 2 BYTES
00390          LEAY     -1,Y     DECREMENT SCN #
00400          BNE      CLK010  GO IF NOT DONE
00410          RTS            RETURN
00420  GETSER LDA      $FF22   GET SERIAL BIT
00430          ANDA     #1      TEST
00440          RTS            RETURN
00450  *****
00460  * INPUT, INPUTS 14 BITS AND STORES IN TWO BYTES *
00470  * ENTRY: BUFFER ADDRESS IN U *
00480  * EXIT: 2 BYTES STORED IN BUFFER, U UPDATED *
00490  *****
00500  INPUT BSR      INPUA   GO TWICE
00510  INPUA CLRA      0 TO A
00520          STA      ,U     CLEAR BYTE
00530          LDB      #8     FOR 8 BITS
00540  INP010 LDA      $FF22   GET BIT
00550          LSRA      OUT TO C
00560          ROR      ,U     MERGE IN USER STACK
00570          LDA      #20     1 CYCLE COUNT
00580          BSR      DELAY   DELAY 1 CYCLE
00590          DECB     DECREMENT ITERATION COUNT
00600          BNE      INP010  GO IF NOT 8
00610          LEAU     1,U     POINT TO NEXT STACK BYTE
00620          RTS            RETURN (AGAIN OR CLOCK)
00630  *****
00640  * DELAY, DELAYS IN MULTIPLES OF .63333 MS *
00650  * ENTRY: COUNT IN A *
00660  * EXIT: AFTER DELAY *
00670  *****
00680  DELAY LDX      #92      FINAGLE FACTOR
00690  DEL010 LEAX     -1,X     DECREMENT X
00700          BNE      DEL010  GO IF NOT 0
00710          DECA     DECREMENT MAJOR COUNT
00720          BNE      DELAY   GO IF NOT 0
00730          RTS            RETURN
00740          END
```



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### HEXADECIMAL LOCATION

HEXADECIMAL LOCATION	DIGIT D	DIGIT G	
3 F F 0			
3 F F 1	0 0	DIGIT A	1 1 ← SCAN NUMBER
3 F F 2		DIGIT E	
3 F F 3	0 0	DIGIT B	1 0 ←
3 F F 4		DIGIT F	
3 F F 5	0 0	DIGIT C	0 1 ←

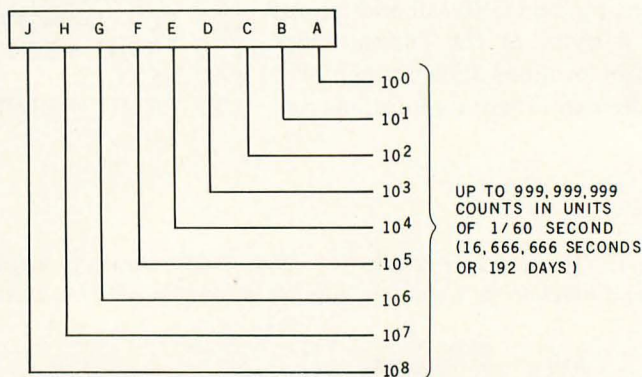


Figure 8: The 6 bytes of count data from the half-year clock contain nine BCD digits and three scan numbers. The order is based on the functional layout of the hardware and the data must be rearranged by the interface software.

COUNT = 000289457 = 4824<sup>+</sup> SECONDS

DECIMAL

144	9,0	1 0 0 1	0 0 0 0	
31	7	0 0	0 1 1 1	← DS 1
128	8,0	1 0 0 0	0 0 0 0	
22	5	0 0	0 1 0 1	← DS 2
32	2,0	0 0 1 0	0 0 0 0	
17	4	0 0	0 1 0 0	← DS 3

SAMPLE 1

144	9,0	1 0 0 1	0 0 0 0	
23	5	0 0	0 1 0 1	← DS 1
128	8,0	1 0 0 0	0 0 0 0	
10	2	0 0	0 0 1 0	← DS 2
32	2,0	0 0 1 0	0 0 0 0	
21	5	0 0	0 1 0 1	← DS 3

SAMPLE 2

COUNT = 000289525 = 4825<sup>+</sup> SECONDS

Figure 9: These are typical data samples. Sample 1 represents a count of 000289457, or 4824.XX seconds. Sample 2 occurred after sample 1 and represents the next count of 000289525, or 4825.XX seconds.



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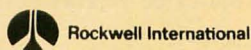
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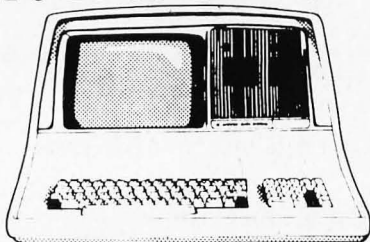
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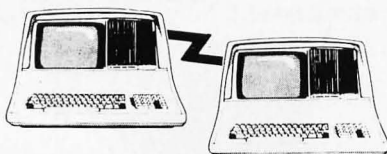
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**Listing 3:** This BASIC program interfaces to the assembly-language clock driver. It converts the 6 bytes of clock data into a count of days, hours, minutes, and seconds, and checks for error conditions.

```
100 INPUT "TIME IN 60THS";T2
110 CLS
120 DEFUSR0=&H3F00
130 T0=-1
140 A=USR0(0)
150 A=INT(PEEK(&H3FF1)/4)
160 B=INT(PEEK(&H3FF3)/4)
170 C=INT(PEEK(&H3FF5)/4)
180 D=INT(PEEK(&H3FF0)/16)
190 E=INT(PEEK(&H3FF2)/16)
200 F=INT(PEEK(&H3FF4)/16)
210 G=(PEEK(&H3FF0) AND 15)
220 H=(PEEK(&H3FF2) AND 15)
230 J=(PEEK(&H3FF4) AND 15)
240 T1=(J*100000000+H*1000000+G*100000+F*10000+E*10000+D*1000+C*100+B*10+A)
245 IF T0=-1 THEN T0=T1
250 IF T1<T0 THEN GOTO 140 ELSE IF T1-T0>999 THEN GOTO 140 ELSE T0=T1
260 T3=T1+T2: IF T3>999999999 THEN T3=T3-999999999
270 T3=INT(T3/60)
280 D=INT(T3/86400):H=INT((T3-D*86400)/3600):M=INT((T3-D*86400-H*3600)/60):S=T3-D*86400-H*3600-M*60
290 PRINT @ 256, "DAY";D;"HOURS";M;"MINS";S;"SECS"
300 GOTO 140
```

Text continued from page 117:

A general-purpose BASIC driver is shown in listing 3. This program displays the actual number of days, hours, minutes, and seconds represented by the count in the HYC. This count can be held in a Color Computer BASIC variable, which allows nine decimal digits of precision.

A "bias" count can be input to the program before sampling the HYC. This bias may be positive or negative to adjust the current count to a previous starting point or to "trim" the time. The unit of bias is  $\frac{1}{60}$  second. Thus, use a value of 60 for every second, 3600 for every minute, 216,000 for every hour, or 518,400 for every day. The momentary-contact RESET switch resets the entire count to 0.

The tests of the current count (T1) with the previous count (T0) require some explanation. In most cases, the sampling process reads count data in a "nonchanging" state. However, because the scan clock occurs at unpredictable times, the count may be sampled in the middle of a scan clock "edge," yielding invalid data. Because of this, T1 (current) is compared to T0 (old). If T1 is less than T0, T1 is invalid and another sample is made. If T1 is greater than T0 by 999 counts (16.65 seconds), T1 is considered invalid and another sample is made. The typical display generated by the program shows the time changing

every 2 seconds, with occasional lapses of up to 4 seconds.

Tests run over several days showed less than one (detected) invalid read per minute with a maximum delay of 5.5 seconds. No invalid times appeared.

If the HYC is to be called at random times, make three calls and test for ascending counts with a difference of less than 10 seconds or so. Using this method, the resulting time will be accurate to within 10 seconds of the counter time.

The crystal used should provide an excellent time base. It can be fine-tuned, however, by substituting a 5 to 50-picofarad (pF) "trimmer" capacitor in place of the 4.7-pF capacitor connected to the crystal.

In operation, the HYC can be disconnected from the system at any time (without turning off the Color Computer) and left running. It can be reconnected at any later time. (Stop the BASIC program above if this is done to prevent a hang-up caused by T1-T0 being greater than 999.)

If Rip van Winkle had owned a Color Computer, he would have loved the half-year clock. If you have nothing to do for the next 192 days, why not check this project out with your Color Computer to test its accuracy? Or count clock pulses instead of sheep: 999,998,767; 999,998,768; 999,998,769 (yawn) . . . ■



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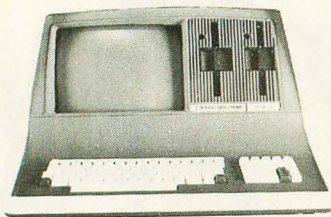


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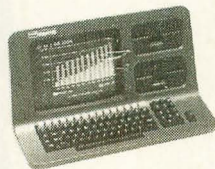


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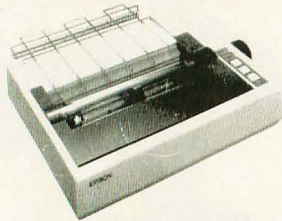
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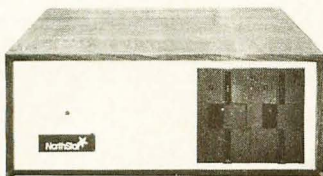
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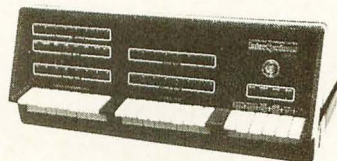
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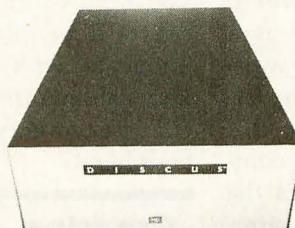
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# The Input/Output Primer

## Part 2: Interrupts and Direct Memory Access

---

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---

Last month we left the computer waiting patiently for the printer to signal its readiness to receive another character. If you think it's wasteful to make a machine as expensive as a computer spend most of its time waiting on slower equipment, you are definitely thinking ahead. Later in this month's article, I'll explore a communication mechanism that lets the computer work on another task after transmitting a piece of information. This mechanism, known as the *inter-*

*rupt*, enables the computer to go about its business until the printer is ready for more data. First, though, you need to know how a computer selects a peripheral device to communicate with; you also need to know about *interfaces*—the hardware that connects computers and peripherals.

---

**Creating subaddresses ensures that information of different kinds can be directed to the proper section of the device.**

---

### Picking and Choosing

In the first article of this series, I briefly discussed *peripheral address lines*. Computers, which generally have several peripheral devices attached, select a particular device in one of two ways. One method is to have a separate I/O connection for

every device connected. Selecting a particular device is merely a matter of sending information on the proper bus. This technique, however, rapidly creates a rat's nest of wires, something that's impractical to manufacture.

An I/O *bus* has a set of peripheral-address lines that the processor uses to specify a device. This greatly simplifies wiring the system and results in major cost savings, although it does limit the computer to communicating with one peripheral at a time. For most computer processors, though, one is the limit anyway.

### Multiplexing Peripherals

Peripheral-address lines allow the I/O bus to be shared or *multiplexed* by many devices. Each device must have a unique address on the bus. Otherwise, conflicts will arise when two devices try to use information on the bus simultaneously. For instance, plotters are useful for graphing data but are terrible for listing programs.

This article is the second in Steve Leibson's six-part series, "The Input/Output Primer." The series will explain the way in which computers talk with the world. Upcoming articles will discuss parallel and HP-IB (GPIB) interfaces; BCD and serial interfaces; character codes; and interrupts, buffers, grounds, and signal degradation. An I/O Glossary, which defines many terms used in these articles, appeared with the first installment (February 1982 BYTE, page 122). Figure and table numbers are continued from Part 1.



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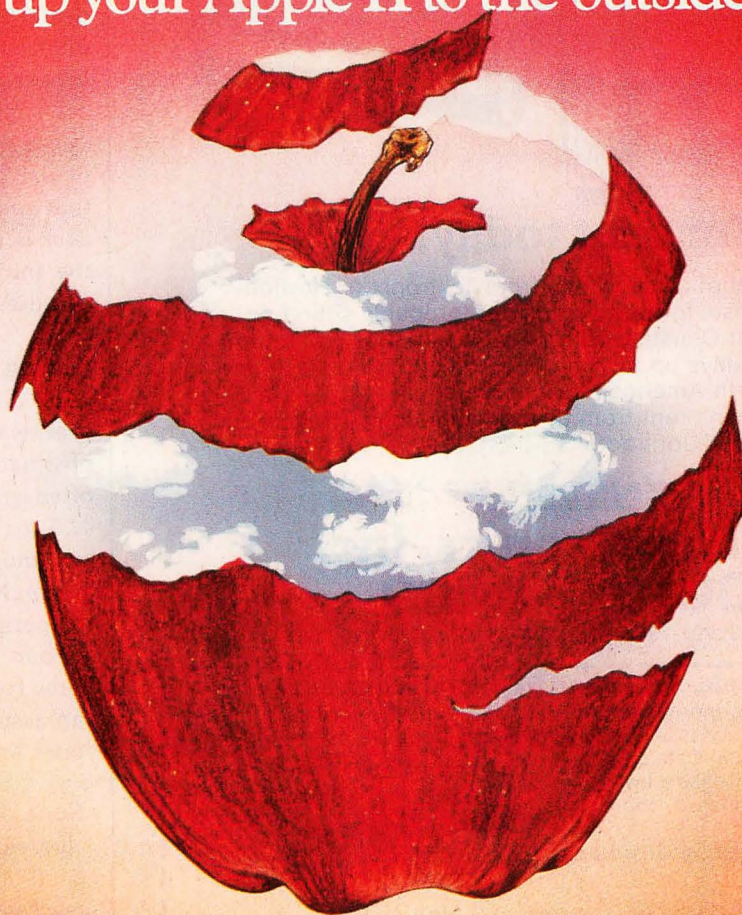
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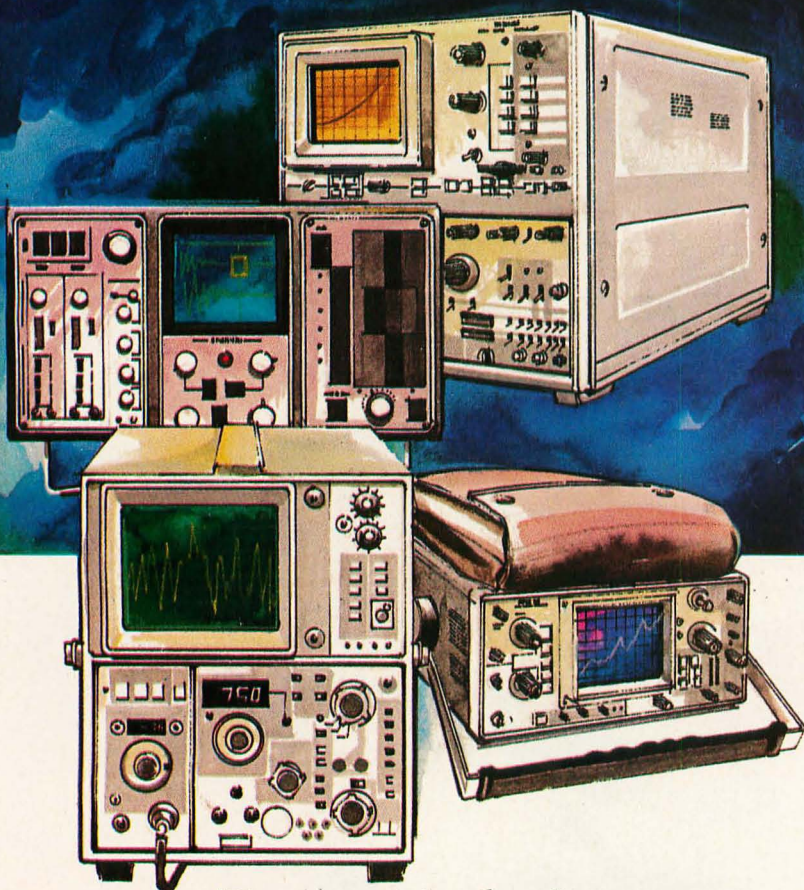
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When the computer is accessing the disk storage device, everything will run more smoothly if the plotter ignores transactions on the I/O bus.

Clearly, each peripheral device must have its own unique address. It's more advantageous, however, for each device to have several unique addresses. Think of the peripheral device as an apartment building having a single, unique street address. Apartment One gets the local daily newspaper, which covers general information, while Apartment Two gets *The Wall Street Journal*, which reports on economic events. Each apartment gets information but of a different kind.

A peripheral device also requires information of different kinds. Not only do printers receive characters to print, but they also get control information such as line spacing, number of characters to print per line, type font, and other functions. Creating subaddresses within the peripheral device ensures that information of different kinds can be directed to the proper section of the device.

Peripheral address lines are split into a *select code* that specifies a particular peripheral and a *register code* that specifies the subaddress. (A *register* is a hardware device that holds the information until the peripheral can use it.)

## Setting up Subaddresses

To illustrate, I'll create four subaddresses within each select code. Being obstinate, as computer designers often are, I'll call these subaddresses 4, 5, 6, and 7 (nobody starts at zero any more). These four subaddresses are registers that serve as portals to the peripheral.

Four subaddresses require two wires for selection because two wires can assume four binary states. These states are:

State of line #1	State of line #2	Register addressed
0	0	4
1	0	5
0	1	6
1	1	7

(Remember, digital signals may only



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assume one of two states: on or off, "1" or "0.")

Although four registers could do the job, there's a complication: the data lines are bidirectional, and bidirectional registers are complex to construct. It's easier to use eight registers—four for input and four for output. The I/O line will specify from which group of four the register address lines will select. Remember that the I/O line specifies the direction of data flow on the data lines and so is ideal for selecting between the input and output registers.

I've now constructed a simple I/O bus that can convey information between the computer and external devices. This I/O bus isn't the most advanced, but it will satisfy present needs. I'll upgrade this "bunch of wires" later, but first let's confront a more pressing problem.

## Introduction to Interfaces

The I/O bus discussed above is a subset of the bus used in the Hewlett-Packard desktop computers, model 9825 and Systems 35 and 45. It would be convenient if all peripherals came with circuitry that directly interfaced to the I/O bus.

Unfortunately, present interfacing methods are far from ideal. The bus constructed above is *parallel-oriented*, which means that every binary digit (bit) of a piece of information (such as a character) is available simultaneously on the 16 data lines.

Not all peripherals use 16 data lines; some peripherals don't have any parallel interfaces but instead send information one bit at a time in a time-serial fashion. No peripherals use the eight-register scheme discussed above, while several use incompatible voltage levels to represent "1" and "0." This appears to be quite a problem. In fact, there isn't a single peripheral that can talk to our I/O bus in its present state.

## Interfaces as Translators

It's necessary to interpose some specialized circuitry between the I/O bus and the peripheral device to adapt the signals from the computer to those used by the peripheral. This



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specialized circuitry is called an *interface*. The interface, which actually plugs into the I/O bus, acts as an intermediary, translating voltages, signal formats, and whatever else is required to establish communications between the computer and the peripheral.

If every peripheral manufactured in the last decade required a different interface, it would be impossible for the computer to communicate with even a small fraction of them. Computer manufacturers simply cannot make products for that many different interfaces. Fortunately, several devices require only one of four basic types of interface: parallel I/O, serial I/O, HPIB (GPIB), and BCD (binary-coded decimal).

To connect with a peripheral, the parallel interface uses a set of wires much like those of the I/O bus. This interface is the most common among current peripherals because it's the simplest to build and usually transfers data the fastest. Major variations involve (1) the connector used between the peripheral and the interface circuitry and (2) the sense of the data and control lines. Does zero volts mean logic zero (positive true logic) or logic one (negative true logic)?

A flexible parallel interface should be available with several connectors and an unterminated cable so that a custom connector can be installed. The logic sense of the data and control lines and even the logic levels used can all be adjusted to suit the needs of a particular device.

A serial interface takes data from

the I/O bus and serializes it into a stream of bits. Incoming serial data is converted into parallel data and sent to the computer. Only two wires are required for serial communications—transmit data and receive data—however, control lines exist in serial interfaces because serial I/O dominates the special environment of long-distance data communications.

---

### **Interrupts force the processor to leave the part of the program it's executing and start executing the code in a different location in memory.**

---

HPIB, a relatively new interface, is standardized. HPIB stands for Hewlett-Packard Interface Bus. Due to standardization, it's also known as the General Purpose Interface Bus (GPIB). Formally known as IEEE-488-1978, HPIB has well-defined signals, connector, logic sense, and logic levels. This interface allows simple connection to multiple devices over a bus structure. Since the connector and signals are standardized, you just bolt the connecting cable to the peripheral for the computer to begin communicating. You then can concentrate on the software needed to run the peripheral. A single HPIB interface can connect a computer to 14 peripheral devices.

Older instruments use a different type of interface known as binary-coded decimal (BCD). Data is transferred in 4-bit chunks, and each group of 4 bits represents a numeral (0 through 9). BCD interfaces are generally used for transmitting numeric information.

In the third and fourth installments of this primer, I'll examine these types of interfaces in depth. For now, though, let's turn to this month's main topic, interrupts and direct memory access (DMA).

### **Getting the Processor's Attention**

What do you think is the most important part of a telephone? The dial? The receiver? The cord? I submit that it's the bell. If the telephone had no way to summon you when a call came in, you'd have to check it periodically to see if there was someone on the line. Having to lift the receiver every few minutes would make the instrument a maddening inconvenience. Fortunately, telephones do have bells that interrupt you when someone calls.

Earlier I discussed the relative speeds of computer processors and peripheral devices. The mismatch in speeds forced the creation of *handshaking* lines the processor could check to determine the peripheral's availability. Without these lines, the speedy processor would inundate the poor peripheral with data. Using these handshake lines is the simplest form of I/O. The computer spends much of its time patiently waiting for the peripheral to signal readiness for



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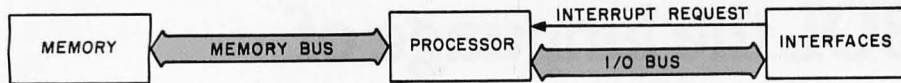
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**Figure 4:** A computer system with memory bus, I/O bus, and added interrupt line. Interrupts allow the processor to start I/O processes, then go on to other tasks. The peripheral uses the interrupt line to indicate readiness for another transaction.

the next transaction.

## Interrupting

Waiting for peripherals is tolerable if the computer has nothing else to do. Often, however, there are many other things the computer could be doing, making the handshaking I/O highly inefficient. Fortunately, most computers now offer an alternative called *interrupt I/O*.

Let's first make clear exactly what will be interrupted. The computer is continuously executing a program in its memory. If there's no user program running, then at least the operating system will be. Thus there are at least two program levels in the computer, with the higher level being the user program, usually written in a language such as BASIC.

Because microprocessors can't run a BASIC program directly (although that day isn't far off), they use a lower-level program called an *interpreter*, which is written in a machine language the processor can run directly. The interpreter takes the BASIC program and interprets it by deciding which machine-language routines to call to perform the tasks requested in the BASIC program. Another type of lower-level program, a *compiler*, can translate a high-level language program into machine code. I'll consider only interpreters here.

*Interrupts* are hardware mechanisms that force the processor to leave the part of the program it's executing and start executing the code in a different location in memory. Figure 4 shows the I/O bus with an interrupt request line added. That's the only change the bus needs in order to add interrupt capability.

Interruption takes place at the machine-code level. It's helpful in synchronizing external events with the computer program but must be used carefully. Let's take an example.

Suppose a user program asks the computer to calculate the value of

$2.5 + 2.5$ , produce the resulting value on a printer, then calculate the value of  $3 + 3$ . The computer will first execute the BASIC interpreter's routine for floating-point addition and produce the first sum: 5.00. Then there will be six characters to print: 5, ., 0, 0, <CR>, and <LF>. <CR> and <LF> are carriage return and linefeed characters usually sent to advance the printer to the next line on the paper.

Assume the addition takes around two milliseconds. If the printer produces ten characters per second, it will take 0.6 seconds to print the first answer (actually, a little more time will be needed because carriage return and linefeed take extra time on most printers).

Handshake I/O requires the computer to wait the full 0.6 seconds before calculating the second sum because the computer is waiting to send the printer another character during that time.

Interrupt I/O's alternative is to place characters to be printed in a buffer somewhere in memory. Interrupt routines can then withdraw characters from this buffer whenever the printer can accept them, and the computer can push on through the program.

## Interrupting Machine Code

When the first character to be printed is removed from the buffer and sent to the printer, the printer interface "goes busy," transferring the character to the printer and waiting for a signal that indicates completion of the printing. Meanwhile, the computer can proceed to the next BASIC statement. When that first character has finally been printed, the printer will "go ready" for the next one. At that time, the printer interface will interrupt the processor and request another character.

Note that the machine code interpreter is interrupted, *not* the BASIC

program. The flow of execution of the BASIC statements is not changed but merely halted while the interruption is serviced. The interpreter, however, does branch to a different routine. This special routine, also in machine code, is called an interrupt service routine. The author of the BASIC program doesn't have to write interrupt service routines for Hewlett-Packard desktop computers, as needed routines are provided in the interpreter. This is convenient because interrupt service routines must handle many factors.

An interrupt forces a branch to the location in memory where the interrupt service routine is stored. If the processor doesn't remember where it was before the interruption, the processor will be unable to return to that location. In fact, the processor will be "lost" and unable to continue processing. Most microprocessors automatically save the address of the location being executed before the interrupt, and a return from the interrupt is sufficient to store that address.

If the interrupt routine uses any of the internal registers in the processor, the routine must carefully save the contents of these registers before using them. This procedure is called *context switching* because the registers will be used for a different purpose in the interrupt service routine than in the main program. Upon completion of the interrupt service routine, the routine must restore the saved values of the registers.

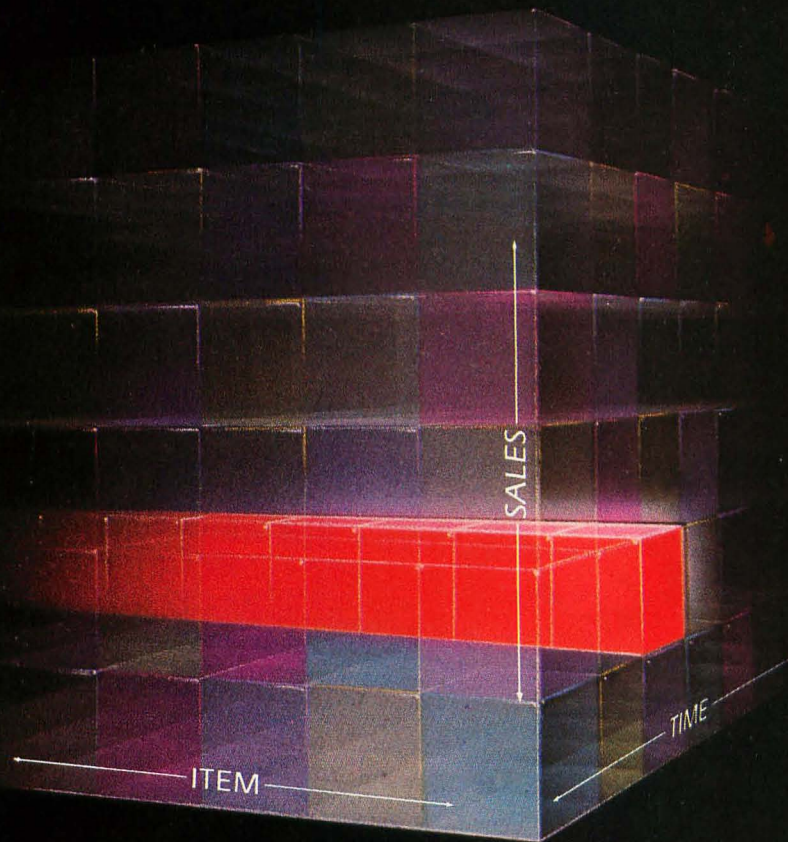
## Interrupting BASIC

Occasionally, the buffered I/O routines for servicing interrupts are not sufficient for handling a problem. Some interrupts are more complex than those needed for data transfer. Maybe the computer is monitoring a water system and the dam bursts. Such crises require the processor's immediate attention; a simple data transfer will not suffice. A branch is needed in the high-level program to a special high-level routine written to handle the interrupt. You *did* write the "Dam Burst" routine, didn't you?

Interrupting a program in BASIC or another high-level language is considerably more complex than inter-



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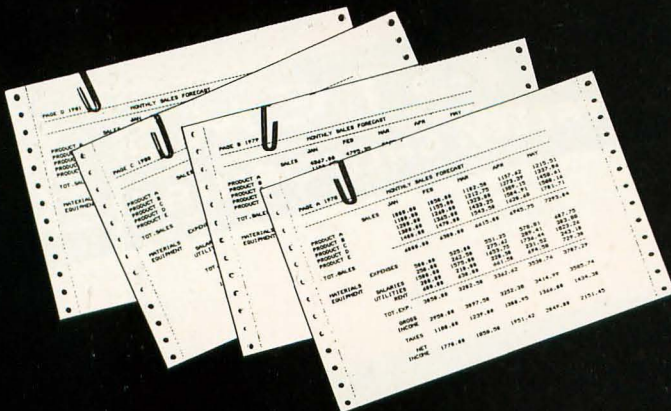
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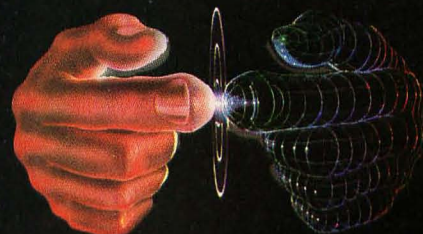
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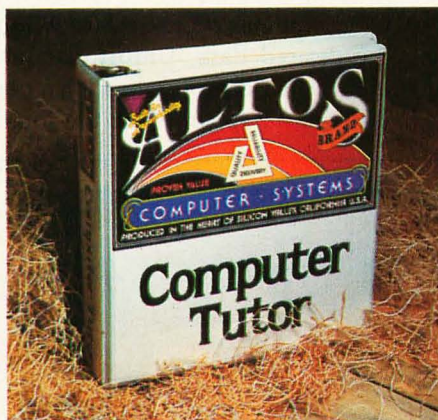
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rupting a machine-language routine for data transfer. High-level statements can affect large portions of memory through the use of variables, arrays, and strings. If a variable is in the process of being changed when the interrupt comes in and the BASIC interrupt routine uses that same variable, the interrupt routine may use the wrong value or a garbled value. If the dam has burst and you need to close some locks downstream immediately to save a town, you and the townspeople have a strong interest in seeing that the interrupt routine uses the right value.

### End of the Line

To prevent such problems, Hewlett-Packard desktop computers allow the BASIC program to be interrupted only at the completion of program line execution. This feature is called *end-of-line branching* because the branch to a BASIC interrupt service routine is allowed only when the end of a line is reached. The interrupt may occur at any time and will be

logged in, but it will not be serviced until the end of the current program line.

Machine-code or low-level interrupts are generally called *hardware interrupts* because the processor hardware grants the interrupt request and performs the subsequent branching. Interrupts to the BASIC or high-level program are called *software interrupts* because several instructions in the operating system are required to log in the interrupt, request an end-of-line branch, then take control of program flow at the end of the line.

### A Misunderstanding

A classic example of misunderstanding interrupt operations occurs whenever a first-time writer of interrupt service routines tries to use an interrupt for input. The typical programmer will enable the interface to interrupt and expect that when the interrupt comes, the interface will have the desired data. Unfortunately, the interface interrupts when it isn't busy. This may happen when the interface

wasn't told to do anything or when an operation has completed. Since the interrupt routine didn't originally make the interface busy by requesting a data input operation before the interrupt was enabled, the interface interrupts immediately but has nothing to offer. Such a miswritten interrupt routine always produces incorrect information on the first data transfer. Remember, to use interrupts properly, you must see that data transfer is started before interrupts are enabled. That way, the first interrupt will occur when the first data transfer is complete.

### DMA: The I/O Superhighway

Thus far, I've covered the hardware within a computer and the interfacing circuitry necessary to interface peripheral devices with computers. All the discussions have assumed that the computer processor is in control of the data-transfer process, which is true for many peripheral devices. The processor is usually fast enough so that the peripheral determines the data-transfer rate.

Some devices, however, are too fast for processor-controlled I/O. These devices can handle data at rates approaching the speed of the computer memory and therefore require a different I/O technique. One technique for interfacing these fast peripherals is called direct memory access.

If the peripheral device is slightly slower than the computer processor, the processor may be able to execute only the few machine instructions needed for the I/O transfer before the peripheral is ready for another transfer. In that case, there's a good match between the I/O software and the peripheral speeds, and programmed I/O will suffice for the task.

Some peripherals, however, are too fast for the processor to execute even the few instructions needed to perform programmed I/O. As long as these peripherals are not faster than the computer's basic memory cycle, direct memory access can perform the required I/O.


In order to discuss DMA and how it works, we must return to the model of the processor/memory/I/O sys-



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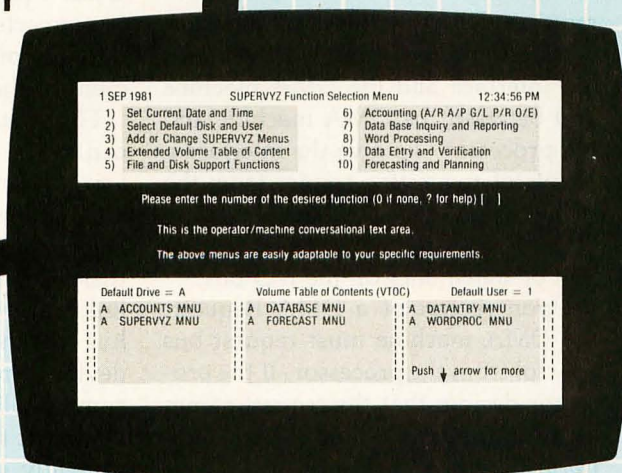
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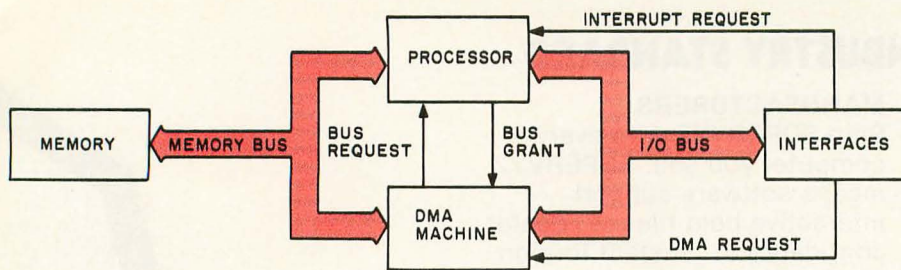
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**Figure 5:** A computer system with an added DMA (direct memory access) machine. The DMA machine, which parallels the processor, can generate the signals necessary for controlling both the memory bus and the I/O bus.

tem. Recall that the processor is linked to the memory via a set of lines called a memory bus and to the I/O interfaces via an I/O bus. Both buses require the processor to generate address signals and control signals to synchronize the flow of data over these buses.

Generally, I/O consists of taking information from the interfaces through the I/O bus and transmitting this information to the memory using the memory bus—or vice versa. During this transfer, the processor is also using the memory and memory bus to supply machine instructions so that it knows how to effect the data transactions. If you assume that the processor takes only nine machine instructions to perform one data transaction, you can see that the effective I/O throughput is only ten percent of the rate that the memory could support. That is, of every ten memory cycles, nine instruct the processor and only one places data for I/O. Only the simplest data transactions can be performed with nine machine instructions. Formatting and code conversions require many more instructions.

The only way to speed up the I/O process is to eliminate the slowest link in the data path. For high-speed peripherals, the slowest link is clearly the processor itself! How can you eliminate the processor when it's the component that links the I/O and memory buses and is required for generation of the signals that actually make these buses work? The answer is to build a specialized circuit designed to transfer data at the full speed of memory. Since this transfer is the only function this circuitry must perform, the capability can be wired into the circuit. Instructions from memory, which would reduce

the effective memory bandwidth, are not needed.

By placing this special circuitry so that it bridges the I/O and memory buses and also by giving it the capability of generating the address and control signals required by these buses, you then have a machine that can perform I/O at the full speed of memory. Such special circuitry is called a direct memory access machine. Figure 5 shows how one might add a DMA machine to the I/O bus.

All that remains is to decide which device will have control of the buses: the processor or the DMA machine. Normally, the processor will have control of the buses, since the DMA I/O must be infrequent enough to allow some processing to get done. The DMA machine must therefore have a way to acquire bus control from the processor whenever necessary. The processor can enable the DMA machine to request bus control, but the interface must actually request service through the DMA machine because only the interface knows when an attached peripheral requires DMA service. Thus some connecting signals must exist between the interface and the DMA machine and between the DMA machine and the processor. To give the interface a means of requesting service from the DMA machine, let's add a signal called *DMA Request* (DMAR) to the collection of signal lines on the I/O bus.

Upon receipt of a DMA Request, the DMA machine must request bus control from the processor. If the processor decides that the request comes at an inopportune time, it can temporarily withhold transfer of control. This is a job for the ever-present handshake! Let's create two handshake

lines, *Bus Request* and *Bus Grant*. The DMA machine will ask for bus control with *Bus Request* and will take control after receiving a signal on *Bus Grant*. As a result, the processor can maintain control of the memory and address buses as long as required.

The kind of DMA I've been discussing is called *burst DMA* because the data transfer is done in a burst during which the DMA machine totally controls the memory and I/O buses. This provides the I/O with the full speed of the memory bus at the expense of completely halting processor activity. If half the memory bus bandwidth were sufficient to solve the high-speed I/O problem, we could use another type of DMA called *cycle-steal DMA*. In the cycle-steal arrangement, the DMA machine alternates control of the buses with the processor, each using every other memory cycle. Cycle-steal DMA allows the processor to operate at 50 percent efficiency while still providing relatively high-speed I/O.

## Summary

It would simplify matters greatly if all devices could agree on data representation, format, signal levels, timing, or even the number of wires used for interconnection. Attempts at standardization have been made, but the swift pace of computer technology renders some standards obsolete before they're published. In addition, the need for compromises seems to arise with every new system. Older equipment also needs to be interconnected; otherwise, replacement of a computer would dictate replacement of the entire system.

Fortunately, present technology can reach backward as well as forward. The computer itself can make adaptations, since computers excel at changing one value into another. Furthermore, interface circuitry that links the computer's memory or I/O bus to the I/O of the peripheral device can overcome hardware incompatibility. Next month I'll discuss two basic types of hardware interface presently used in computer systems: the parallel and HPIB (GPIB) interfaces. ■



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# A BASIC Plotting Subroutine

## Sophisticated Plotting with Your MX-80

---

Lawrence J. Bregoli  
106 South Longyard Rd.  
Southwick, MA 01077

---

Since the introduction of the MX-80 printer, several articles have described most of its outstanding features, including the remarkable print quality for the price. I'd like to showcase another great feature of this printer: its ability to plot data curves. By combining its features with simple software routines, the MX-80 can emulate sophisticated plotters.

### Plotter Criteria

Several features constitute a good plotting routine. First, it should be a subroutine that, when called, plots data generated in the main program and, if needed, returns to the main program with the data unmodified for further processing. Second, the plot routine should be automatically scaling so that the operator of the main program doesn't have to worry about keeping tabs on all the maximum and minimum values sent to the plotting routine. Last but not least, the hard-copy output should have enough resolution to allow in-

### About the Author

Lawrence J. Bregoli has a bachelor's degree in electrical engineering and is currently employed as a research engineer working on electrochemical aspects of fuel cell research at UTC in South Windsor, CT.

terpretation of the data. After all, that's why a plot was deemed necessary in the first place.

---

### Once a linefeed is generated, there's no turning back.

---

The MX-80 printer easily meets these criteria, as evidenced by figure 1. The plot is a straight line of the form  $y=mx+b$ . Note that the plotting routine provides its own graph paper by inserting horizontal and vertical grid lines; legends for both axes are included. Ah, you say, any print routine could handle a straight line with ease. Figure 2 is a better test of the printer and plotting routine. Here, concentric circles are plotted with radii of 1 and 0.5. Note that the auto-scaling routines in this case must handle both positive and negative values, and that, although the circles are not perfect, they have enough resolution for most plotting applications.

Resolution of these plots is set by the maximum number of data points allowed by the plotting routine. In the plots shown, the number of points

was limited to 101 X,Y pairs. The number of points chosen was based on several criteria. First, the maximum number of print positions that can be set in the horizontal direction is 132. Using 101 of these positions for data plotting leaves 31 positions for printing the Y-axis scale values and the Y-axis title. In the vertical direction, the MX-80 can be set so that every linefeed increment moves the paper up by as little as  $\frac{1}{72}$  inch. Therefore, resolution to a single printed dot can be obtained. I chose only 101 points in the vertical direction for several practical reasons. In most cases, this is all the resolution needed to obtain a smooth fit of the data. Most important, though, each data point plotted takes time to print, and the increased printing time is not warranted in most cases.

### About the Program

The program for generating the plots, shown in listing 1, was written in Microsoft MBASIC 5. The size of the program can be cut down considerably by removing the REM statements and by combining several program lines into one multiple-statement line. As written, the program doesn't need a main program to gen-



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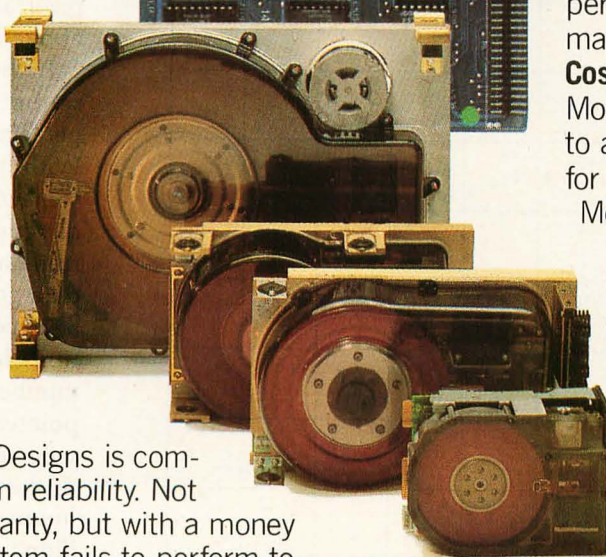
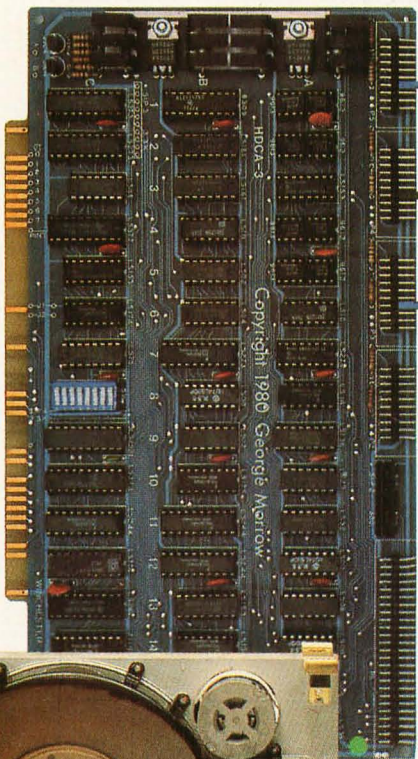
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STRAIGHT LINE -->  $Y=mx+b, b=0$

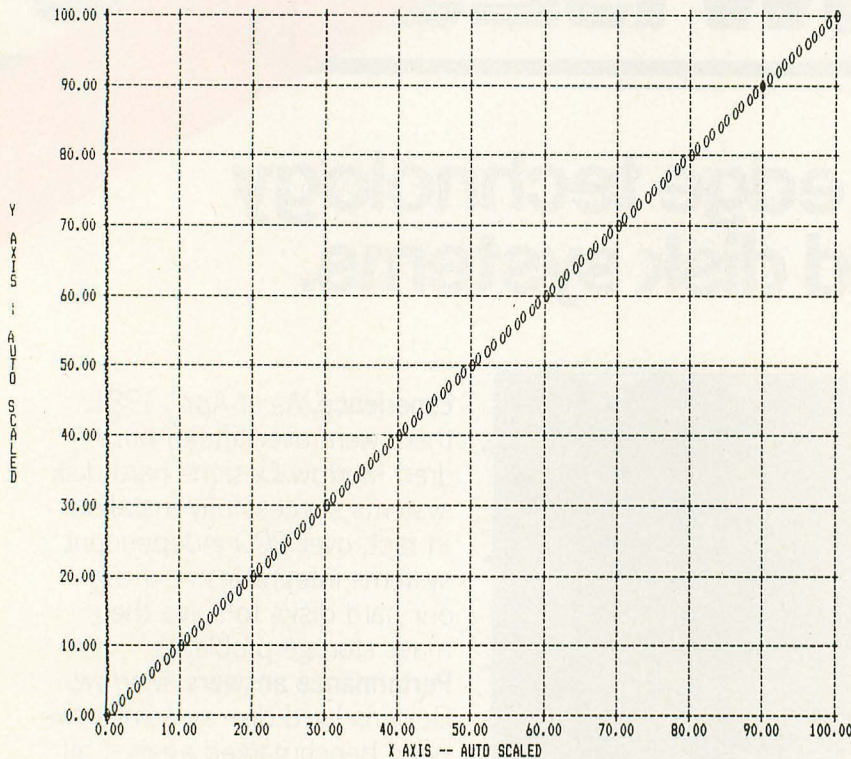


Figure 1: Sample plot of a straight line using auto-scaling ( $y=mx+b, b=0$ ).

CONCENTRIC CIRCLES->Radii=1 and 0.5

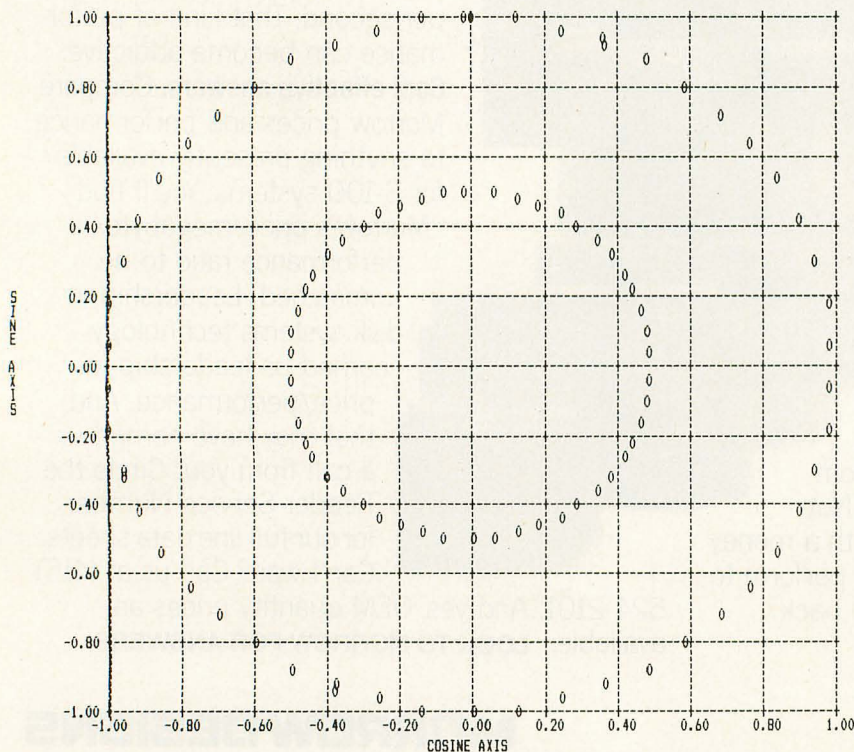


Figure 2: Sample plot of concentric circles using auto-scaling (radii=1 and 0.5).

erate X,Y data sets. It was written this way so that it could be tested immediately for errors using data generated in lines 5120 through 5200. In normal operation, the DIM statement in line 5160 would be in the calling program, and the entry point to the plotting routine would be at line 5250. Line 5670 would also be changed from END to RETURN.

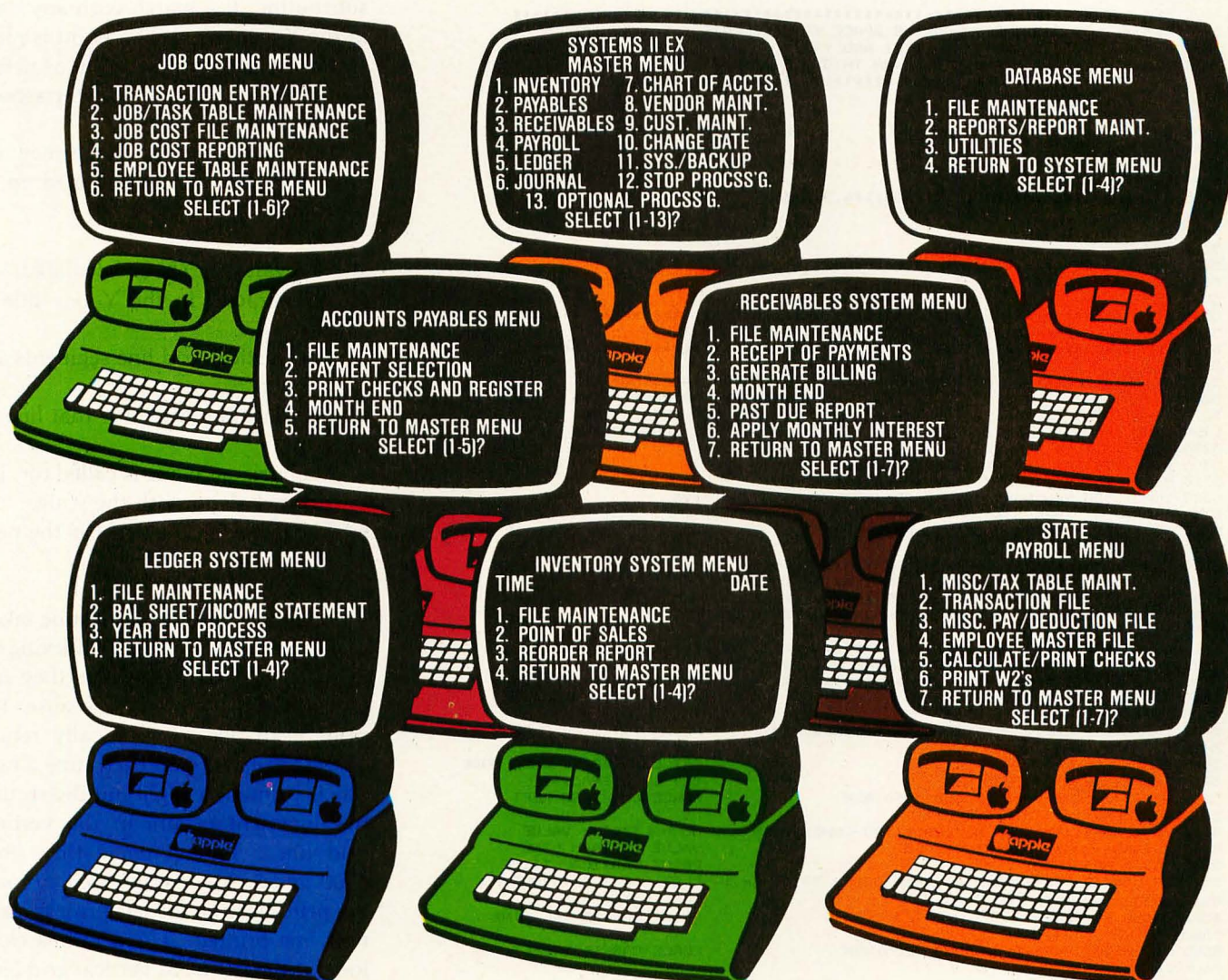
Lines 5250 through 5310 allow the user to enter the graph's title and legends for the X and Y axes. These strings are then centered in 50-character strings so they are printed at the center of the X and Y axes, independent of the title or legend length. Manual or automatic scaling can then be selected by answering the prompt in line 5320.

The main body (lines 5460 to 5670) and its subroutines are where the real plotting action occurs. Most dot-matrix printers print from the top of the page down and do not allow this top-down mode to be reversed. The MX-80 also fits into this category. The resulting limitation forces special handling of the data to be printed so that all the data of a given Y value is printed on a line before the next line-feed occurs. Once a linefeed is generated, there's no turning back to print another data point on the line above it.

In the main body, the first few lines set up the printer for 132 characters per line and  $\frac{1}{36}$  inch per linefeed. With these settings, a plot size of somewhat over  $5\frac{1}{2}$  inches in both directions is obtained when two line-feeds are performed for each of 101 data positions in the Y direction. Line 5520 performs a very important function in that it converts the line number position presently being pointed to on the plot to a numeric value proportionate to the total span of the data, which is set by the maximum and minimum scale values. (I didn't even understand that!) In other words, consider line number 100 to be at the top of the plot and line number 0 at the bottom; also suppose that  $Y_{MAX}=1$  and  $Y_{MIN}=-1$  as shown in figure 2. Then, if the present line number were 20 lines down from the top, the value of YN would be:



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Listing 1: Program listing of MX-80 plotting routine, written in Microsoft MBASIC 5.

```

5000 REM
5010 REM *****
5020 REM *          PLOT PROGRAM FOR MX-80          *
5030 REM *          BY          *
5040 REM *          LAWRENCE J. BREGOLI          *
5050 REM *****
5060 REM
5070 REM *****
5080 REM *          USE THE FOLLOWING SPACE TO CALCULATE A 101 BY 101 *
5090 REM *          DATA ARRAY IN X(I) AND Y(I).          *
5100 REM *          ENTER PROGRAM BELOW THIS SECTION IF ARRAY EXISTS *
5110 REM *****
5120 REM
5130 REM
5140 REM          SAMPLE ARRAY->CONCENTRIC CIRCLES
5150 REM
5160 DIM Y(101),X(101):REM          MOVE DIM TO MAIN PROGRAM
5170 FOR I=0 TO 50
5175 X(I)=SIN(I*.282/50):Y(I)=COS(I*.282/50)
5180 NEXT I
5185 FOR I=51 TO 100
5186 J=I-50
5187 X(I)=.5*SIN(J*.282/50):Y(I)=.5*COS(J*.282/50)
5190 NEXT I
5200 REM
5210 REM *****
5220 REM *          ENTER TITLE OF PLOT AND AXIS LEGENDS          *
5230 REM *****
5240 REM
5250 XTITLE$=SPACE$(50):YTITLE$=SPACE$(50):PTITLE$=SPACE$(50)
5260 LINE INPUT "ENTER TITLE OF PLOT (50 CHARACTERS OR LESS) ";T$
5270 LINE INPUT "ENTER Y AXIS TITLE (50 CHARACTERS OR LESS) ";Y$
5280 LINE INPUT "ENTER X AXIS TITLE (50 CHARACTERS OR LESS) ";X$
5290 MID$(YTITLE$, (LEN(YTITLE$)-LEN(Y$))/2)=Y$
5300 MID$(XTITLE$, (LEN(XTITLE$)-LEN(X$))/2)=X$
5310 MID$(PTITLE$, (LEN(PTITLE$)-LEN(T$))/2)=T$
5320 INPUT "DO YOU WANT (A)UTO OR (M)ANUAL SCALING ";Y$
5330 IF Y$="M" THEN 5360
5340 IF Y$="A" THEN GOSUB 6550 ELSE 5320
5350 GOTO 5460
5360 INPUT "ENTER MAXIMUM VALUE OF Y AXIS";YMAX
5370 INPUT "ENTER MINIMUM VALUE OF Y AXIS";YMIN
5380 INPUT "ENTER MAXIMUM VALUE OF X AXIS";XMAX
5390 INPUT "ENTER MINIMUM VALUE OF X AXIS";XMIN
5400 REM
5410 REM *****
5420 REM *          MAIN BODY OF PROGRAM STARTS HERE          *
5430 REM *****
5440 REM
5450 REM
5460 LPRINT:LPRINT:LPRINT TAB(15);PTITLE$:REM          PRINT TITLE OF PLOT
5470 LPRINT:LPRINT
5480 GOSUB 5810:REM          SET COMPRESSED CHAR MODE
5490 LSPACE=2:GOSUB 5780:REM          SET LINE SPACING
5500 RSTOP=20:CHAR$="!":GOSUB 5850:REM          FORCE CARRIAGE LEFT
5510 FOR LNNO=100 TO 0 STEP -1
5520 YN=YMAX-(((YMAX-YMIN)/100)*(100-LNNO)):REM          NORMALIZED Y VALUE
5530 YD=ABS((YMAX-YMIN)/100):REM          VALUE OF EACH LINE
5540 GOSUB 6250:REM          PRINT VERTICAL TITLE
5550 IF LNNO/2-FIX(LNNO/2)=0 THEN GOSUB 5910:REM          PLOT DATA
5560 GOSUB 6020:REM          PRINT HORIZONTAL LINE
5570 GOSUB 6140:REM
5580 LPRINT
5590 RSTOP=20:CHAR$="!":GOSUB 5850:REM          FORCE CARRIAGE LEFT
5600 LPRINT
5610 NEXT LNNO
5620 GOSUB 6350:REM          PRINT X SCALE
5630 GOSUB 6460:REM          PRINT X AXIS TITLE
5640 LSPACE=12:GOSUB 5780:REM          SET NORMAL LINE SPACING
5650 GOSUB 5830:REM          SET NORMAL CHAR WIDTH
5660 FOR I=1 TO 23:LPRINT:NEXT I:REM          TOP OF NEXT FORM
5670 END
5680 REM
5690 REM *****
5700 REM *          END OF MAIN BODY-SUBROUTINES START HERE          *
5710 REM *****
5720 REM
5730 REM
5740 REM *****
5750 REM *          PRINTER CONTROL SUBROUTINES          *
5760 REM *****
5770 REM
5780 LPRINT CHR$(27)"A"CHR$(LSPACE)CHR$(27)"2":REM          EDIT WITH GRAFTRAX OPTION
5790 RETURN:REM          SET LINE SPACING
5800 REM
5810 LPRINT CHR$(15):RETURN:REM          SET COMPRESSED MODE
5820 REM
5830 LPRINT CHR$(18):RETURN:REM          SET NORMAL MODE
5840 REM
5850 LPRINT SPC(RSTOP);CHAR$;:RETURN:REM          PRINT CHAR AT RSTOP
5860 REM
5870 REM *****
5880 REM *          PLOT VERTICLE LINE SUBROUTINE          *
5890 REM *****
5900 REM
5910 CHAR$="!":RSTOP=20:LPRINT CHR$(13);:GOSUB 5850
5920 RSTOP=9
5930 FOR I=1 TO 10

```

$$\begin{aligned}
 YN &= 1 - (((1 - (-1)) / 100) \\
 &\quad \times (100 - 80)) \\
 &= 0.6
 \end{aligned}$$

This value is subsequently tested against the data in the PLOT DATA subroutine. If a match with any data in the Y array occurs, a point is plotted at the proper X position as determined by the value in the corresponding X array.

The overall action performed on any given line can be summed up as follows:

1. The value of YN is calculated.
2. A character in the Y-axis title is printed.
3. The vertical grid line segments are printed.
4. The data is plotted for that line, if any.
5. If a horizontal line is called for, it's printed along with the scale.
6. The cycle is repeated for the next line down.

A special precaution must be taken to ensure exact horizontal indexing on printers like the MX-80, as they use bidirectional printing. Because the print head doesn't physically return to the left-hand stop each time a new line is printed, a slight but distracting misalignment occurs in the vertical grid lines. To overcome this, lines 5500 and 5590 were inserted to force the print head to the left prior to each new line printed. If you take a close look at the left-hand vertical grid lines in figures 1 and 2, you can see this slight misalignment. If your particular printer is perfectly aligned or if you can put up with a slight misalignment error, then remove these line numbers. Removal of these lines will save a lot of time in actually plotting the data.

While I'm on the subject of time, it takes about eight minutes to complete a plot using the program shown in listing 1. This may seem a bit long to some users, but consider plotting 101 X,Y points by hand from a table of data. I'd rather sip my coffee and watch the MX-80 go about that agony. Later, I'll discuss a way to take about two minutes off this time.

Another program statement which

Listing 1 continued on page 148



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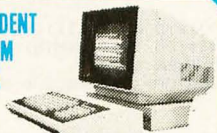
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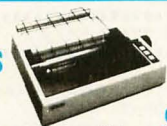
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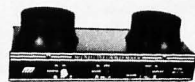
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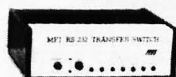
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Listing 1 continued:

```

5940 GOSUB 5850
5950 NEXT I
5960 RETURN
5970 REM
5980 REM *****
5990 REM * PLOT DATA SUBROUTINE *
6000 REM *****
6010 REM
6020 CHAR$="0"
6030 FOR I=0 TO 100
6040 IF (Y(I))>YN+.50001*YD OR (Y(I))<YN-.50001*YD THEN 6080
6050 XP=FIX((X(I)-XMIN)*100/(XMAX-XMIN))
6060 IF XP<0 OR XP>100 THEN 6080
6070 LPRINT CHR$(13);:RSTOP=XP+20:GOSUB 5850
6080 NEXT I:RETURN
6090 REM
6100 REM *****
6110 REM * PLOT Y SCALE AND HORIZONTAL LINE SUBROUTINE *
6120 REM *****
6130 REM
6140 IF LNND/10-FIX(LNND/10)<>0 THEN RETURN
6150 LPRINT CHR$(13);:RSTOP=10:CHAR$="":GOSUB 5850
6160 LPRINT USING "#####.##";(YMAX-YMIN)*LNND/100+YMIN;
6170 LPRINT CHR$(13);:RSTOP=20:CHAR$="-":GOSUB 5850
6180 LPRINT STRING$(100,"-");
6190 RETURN
6200 REM
6210 REM *****
6220 REM * PRINT Y AXIS TITLE *
6230 REM *****
6240 REM
6250 IF LNND/2-FIX(LNND/2)<>0 THEN RETURN
6260 LPRINT CHR$(13);:RSTOP=7
6270 CHAR$=MID$(YTITLE$,FIX((100-LNND)/2)+1),1)
6280 GOSUB 5850
6290 RETURN
6300 REM
6310 REM *****
6320 REM * PRINT X SCALE SUBROUTINE *
6330 REM *****
6340 REM
6350 LPRINT:LPRINT
6360 RSTOP=13:CHAR$="":GOSUB 5850
6370 FOR I=0 TO 10
6380 LPRINT USING "#####.##";(XMAX-XMIN)*I/10+XMIN;
6390 NEXT I
6400 RETURN
6410 REM
6420 REM *****
6430 REM * PRINT X AXIS TITLE *
6440 REM *****
6450 REM
6460 LPRINT:LPRINT:LPRINT
6470 LPRINT:LPRINT:LPRINT
6480 RSTOP=45:CHAR$=XTITLE$:GOSUB 5850
6490 RETURN
6500 REM
6510 REM *****
6520 REM * AUTO SCALING SUBROUTINES *
6530 REM *****
6540 REM
6550 YMAX=Y(0):XMAX=X(0):YMIN=Y(0):XMIN=X(0)
6560 FOR I=1 TO 100:REM FIND XMAX & YMAX
6570 IF Y(I)>YMAX THEN YMAX=Y(I)
6580 IF Y(I)<YMIN THEN YMIN=Y(I)
6590 IF X(I)>XMAX THEN XMAX=X(I)
6600 IF X(I)<XMIN THEN XMIN=X(I)
6610 NEXT I
6620 RESTORE 6830:REM-----
6630 MSD=(YMAX-YMIN)/10:REM SCALE THE Y AXIS
6640 FOR I=-2 TO 4
6650 FOR K=1 TO 3:READ J
6660 IF MSD<=J*10^(I) THEN MSD=J*10^(I):GOTO 6680
6670 NEXT K:RESTORE 6830:NEXT I
6680 FOR I=10 TO -10 STEP -1
6690 IF (YMAX<=I*MSD)*(YMAX>I*MSD-.99999*MSD) THEN YMAX=I*MSD
6700 NEXT I
6710 YMIN=YMAX-10*MSD
6720 RESTORE 6830:REM-----
6730 MSD=(XMAX-XMIN)/10:REM SCALE THE X AXIS
6740 FOR I=-2 TO 4
6750 FOR K=1 TO 3:READ J
6760 IF MSD<=J*10^(I) THEN MSD=J*10^(I):GOTO 6780
6770 NEXT K:RESTORE 6830:NEXT I
6780 FOR I=10 TO -10 STEP -1
6790 IF (XMAX<=I*MSD)*(XMAX>I*MSD-.99999*MSD) THEN XMAX=I*MSD
6800 NEXT I
6810 XMIN=XMAX-10*MSD
6820 RETURN
6830 DATA 1,2,5
6840 REM
6850 REM *****
6860 REM * LIST OF VARIABLE NAMES USED IN PROGRAM *
6870 REM *****
6880 REM
6890 REM Y(I) Y AXIS DATA ARRAY
6900 REM X(I) X AXIS DATA ARRAY
6910 REM YMAX MAXIMUM VALUE OF Y AXIS
6920 REM YMIN MINIMUM " " "

```

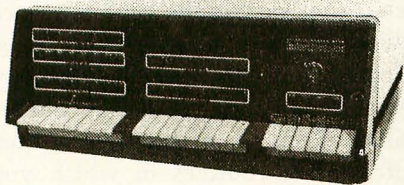
Listing 1 continued on page 150



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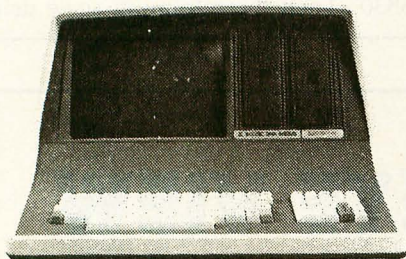
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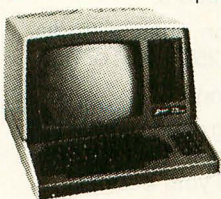
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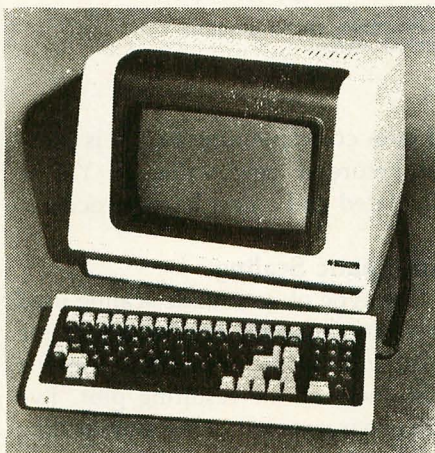


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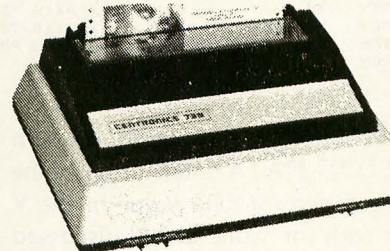
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Listing 1 continued:

```

6930 REM XMAX      MAXIMUM VALUE OF X AXIS
6940 REM XMIN      MINIMUM " " " "
6950 REM LNNO      Y AXIS LINE NUMBER
6960 REM RSTOP     CHARACTER TAB STOP
6970 REM LSPACE    SIZE OF LINEFEED AT PRINTER
6980 REM YN        NORMALIZED Y AXIS VALUE
6990 REM YD        DELTA VALUE FOR EACH Y AXIS LINE
7000 REM XP        CHARACTER POSITION ON X AXIS
7010 REM MSD       MINIMUM SCALE DELTA
7020 REM J         SCALE DELTA
7030 REM K         INDEX COUNTER
7040 REM I         INDEX COUNTER
7050 REM T$        PLOT TITLE
7060 REM PTITLE$   PLOT TITLE CENTERED IN 50 SPACES
7070 REM Y$        Y AXIS TITLE
7080 REM YTITLE$   Y AXIS TITLE CENTERED IN 50 SPACES
7090 REM X$        X AXIS TITLE
7100 REM XTITLE$   X AXIS TITLE CENTERED IN 50 SPACES
7110 REM CHAR$     STRING PRINTED AT RSTOP
7120 REM

```

may be difficult to interpret occurs in the PLOT DATA subroutine. Line 6040 compares a data value in the Y array with the value of YN discussed above. If the value in the Y array equals YN plus or minus 51 percent of the value between lines, it's printed on the plot at an X position determined by the corresponding value in the X array. This value (XP) is calculated in line 6050. The PLOT DATA subroutine checks every data value in the Y array each time the subroutine is called to make sure that

all data corresponding to YN is plotted before a new value of YN is calculated and a new linefeed occurs.

### Automatic Scaling

The type of automatic scaling used in a plot program can be one of the most critical factors in determining usefulness of the resulting plot. I've run programs containing auto-scaling features that actually make the resulting plot worthless. These programs seem to be written so that the highest data point falls on the top line and the

lowest falls on the bottom line—without any consideration of the intermediate scale values. This type of scaling is the easiest to implement but makes data interpretation extremely difficult. One of the problems in developing auto-scaling routines involves individual preference regarding the scales selected. Some people may prefer the type of scaling mentioned above, some may choose scale deltas that vary in the 1-2-5 sequence which many analog plotters have adopted, and others may accept any sequence as long as it has integer values. Because of this, I've written auto-scaling routines in which you can tailor the scaling sequence simply by inserting a new DATA statement with user-selected values.

The auto-scaling subroutines start at line 6550. The extreme values in both the X and Y arrays are determined in lines 6550 through 6610; then the X and Y scales are determined. Determination of the scales starts by restoring the DATA statement in 6830. Then the minimum scale delta

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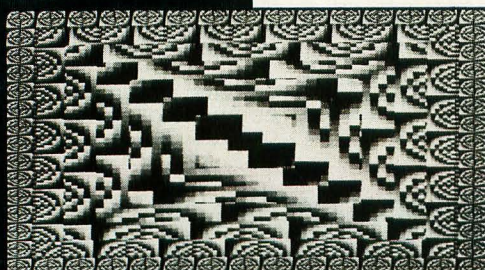
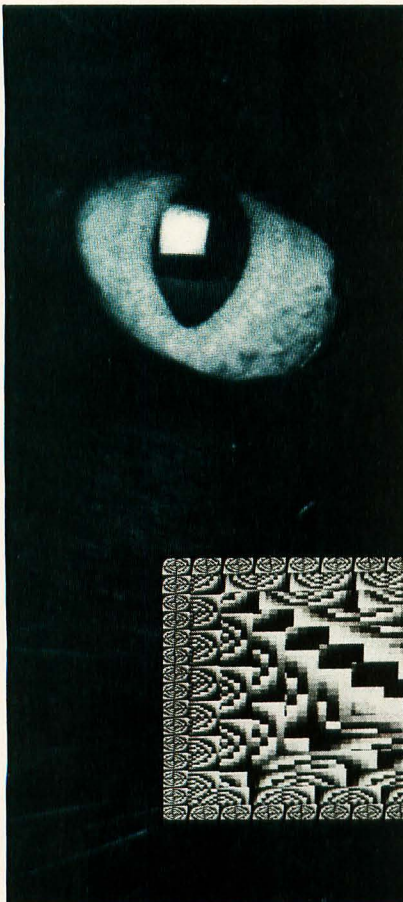
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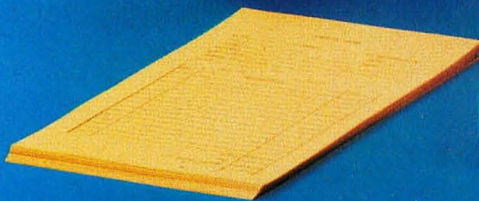
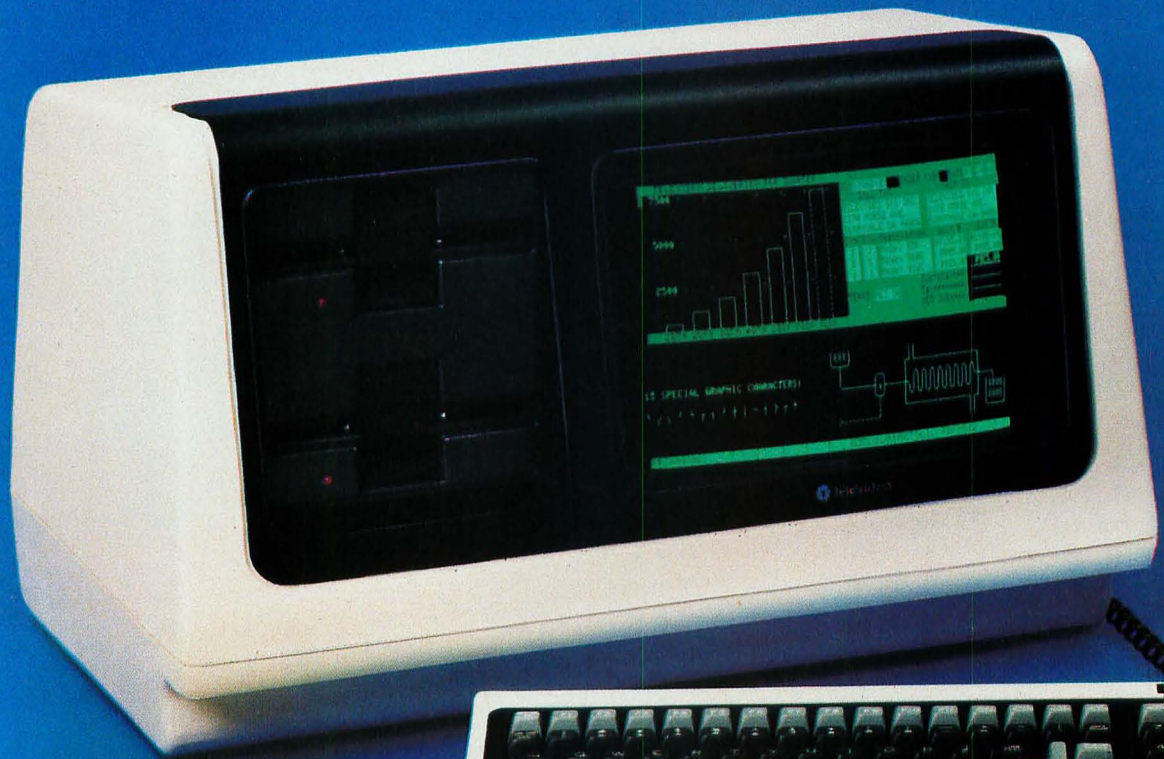
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**Listing 2: Additional software to presort data prior to plotting.**

```

5450 REM
5452 REM *****
5454 REM *   SPEED UP MODIFICATIONS USING SORT ROUTINE   *
5456 REM *****
5458 REM
5465 TOP=100:TEMPTOP=100
5468 GOSUB 6890:REM                                SORT DATA
5470 REM
5480 REM *****
5490 REM *   PLOT SORTED DATA SUBROUTINE               *
6000 REM *****
6010 REM
6020 CHAR$="Q"
6030 FOR I=TOP TO 0 STEP -1
6033 IF Y(I)>YN+.50001*YD THEN 6080
6035 IF Y(I)<YN-.5*YD THEN I=0:GOTO 6080
6040 TEMPTOP=I
6050 XP=FIX((X(I)-XMIN)*100/(XMAX-XMIN))
6060 IF XP<0 OR XP>100 THEN 6080
6070 LPRINT CHR$(13);:RSTOP=XP+20:GOSUB 5850
6080 NEXT I:TOP=TEMPTOP:RETURN
6840 REM
6850 REM *****
6860 REM *   SHELL SORT OF DATA                         *
6870 REM *****
6880 REM
6890 M=100
6910 M=INT(M/2):IF M=0 THEN RETURN
6920 J=0:K=100-M
6930 I=J
6940 L=I+M:IF Y(I)<Y(L) THEN 6970
6950 T=Y(I):T1=X(I):Y(I)=Y(L):X(I)=X(L):Y(L)=T:X(L)=T1:I=I-M
6960 IF I<0 THEN 6970 ELSE 6940
6970 J=J+1:IF J<K THEN 6930 ELSE 6910
6980 REM

```

(MSD) is determined, based on the data extremes. This value is the smallest that can be used between major scale divisions yet still fit all the data on a plot with ten major divisions. Line 6640 starts a

FOR. .NEXT loop which selects the multiplier for the scale divisions; the nested FOR. .NEXT loop beginning at line 6650 selects the value of the major scale divisions using the DATA statement in line 6830. Lines 6660

through 6710 then use this information to determine new maximum and minimum scale values which in turn are used in the data plotting routines. Scaling of both the X and Y axes is handled in the same manner.

Although the logic of these routines would become quite clear with some study, you don't have to understand these routines at all to select your own personalized auto-scaling factors. Simply change the DATA statement in line 6830 and the limit of the FOR. .NEXT loops in lines 6650 and 6750. For example, suppose you like any even integer scaling. Change the DATA statement from 1, 2, 5 to 1, 2, 3, 4, 5, 6, 7, 8, 9, and change the upper limits in the READ loops from 3 to 9. I don't like scales with increments of 3, 6, 7, 8, or 9 and typically use a scaling of 1, 2, 2.5, 4, 5. As I've stated, though, this depends strictly on your esthetic values. The program uses 1, 2, 5 scaling as an example.

Figure 3 is a plot of EXP(X) versus X using 1, 2, 2.5, 4, 5 auto-scaling values. Exponential curves such as

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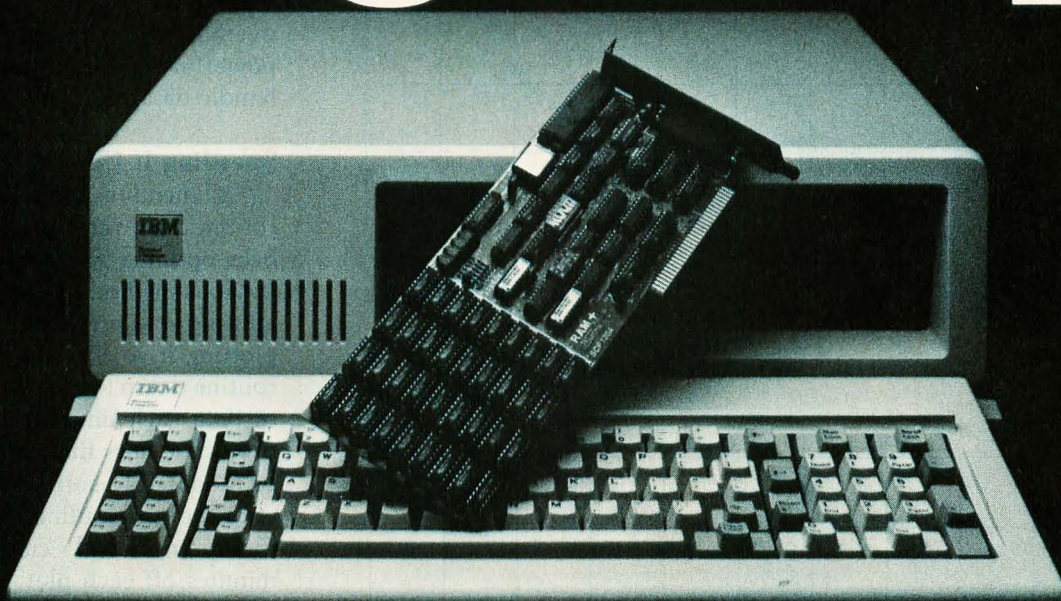
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# EXPONENTIAL CURVE

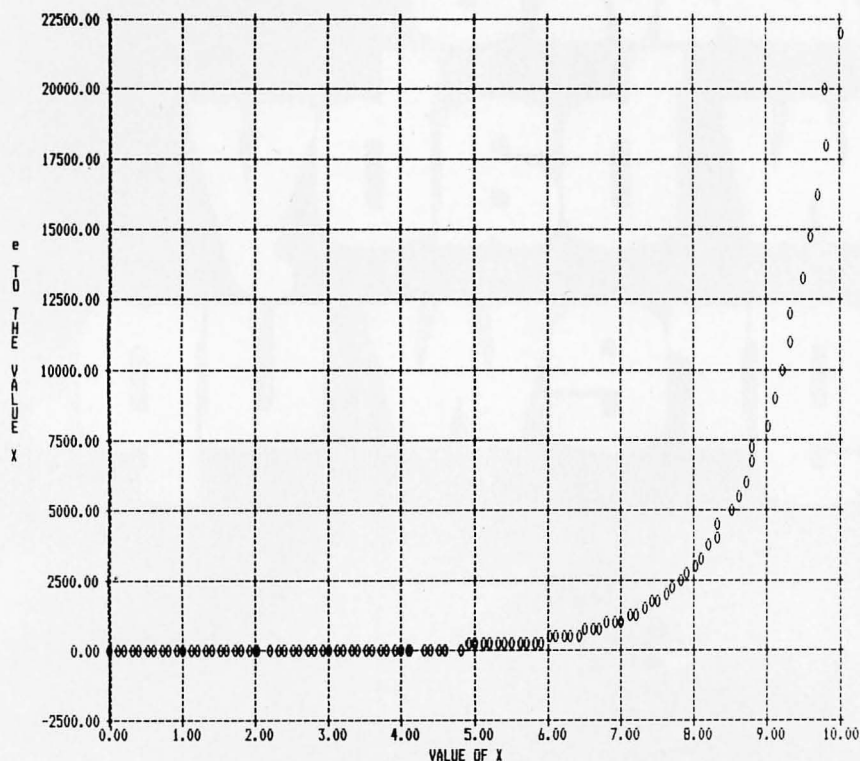


Figure 3: Sample plot of exponential curve using auto-scaling ( $Y=EXP(X)$ ).

# EXPONENTIAL CURVE (LOW VALUES)

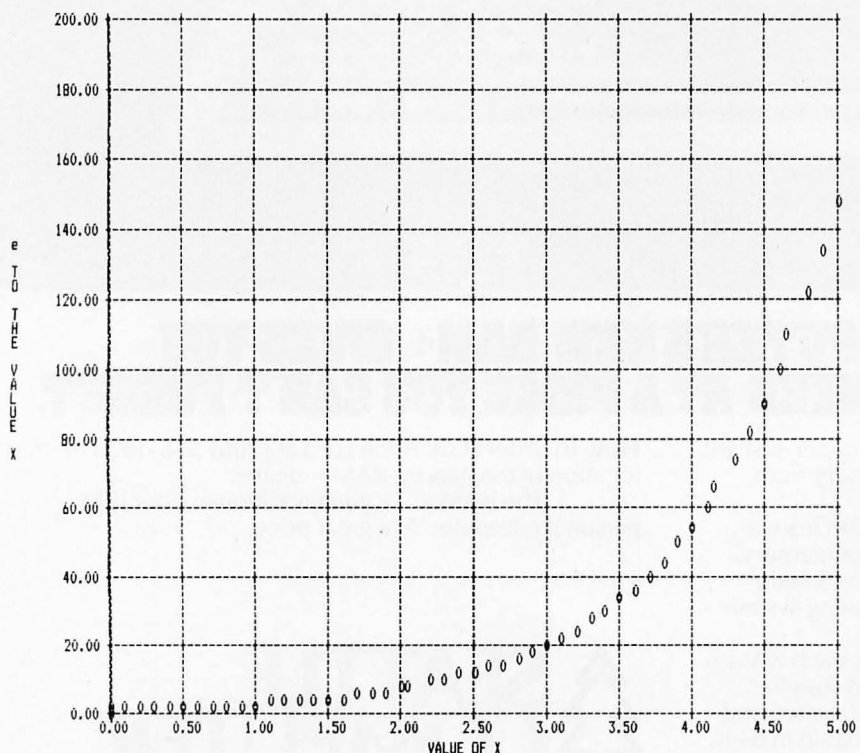


Figure 4: Sample plot of exponential curve using manual scaling (expanded section of figure 3).

the one shown are particularly difficult for any linear plot routine to handle because of the wide range of values usually involved. It's obvious from figure 3 that much of the data falls below the Y value of 200 and below the X value of 5. With this type of data, it's sometimes desirable to have a higher-resolution plot of this section of the data. You can accomplish that by now replotting this section of data using the MANUAL feature of the program. Figure 4 shows a plot of the same data with the Y scale manually set from 0 to 200 and with the X scale manually set from 0 to 5. Use of auto-scaling to present all of the data and manual scaling to expand features of the overall plot can provide a very powerful tool for those who have to handle data regularly.

## Speeding It Up

As I mentioned before, this plotting routine isn't very fast and has never been optimized to make it faster. One obvious method to decrease the overall time is to presort the data prior to plotting it so that the PLOT DATA routine doesn't have to scan every bit of data each time through. Listing 2 shows the lines that have to be added or modified to sort and plot the data with the sort routine given. Inserting these lines will cut almost two minutes off each plot, but there's no free lunch here either. What price is paid for this speed-up feature? The data isn't the same as when it entered the routine, since the array numbers have been altered. You could save the arrays in other arrays to maintain the integrity of your data, but this will cost you variable space. Again, use of these options is strictly up to the user and the particular application.

I've written the software for a standard MX-80 *without* the Grafrax-80 option. Those of you having this option should delete the last part of line 5780, since the `CHR$(27)"2"` is no longer needed.

Please feel free to write and let me know of any features of the MX-80 or of the program I've missed that would reduce the plot time—my mailman will love it! ■





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# Modify Your Paper Tiger for Different Paper Thicknesses

---

R. P. Sarna  
39 Cushnoc Dr.  
Augusta, ME 04330

---

Are you tired of removing the printer cover of your Paper Tiger to adjust for different paper thicknesses? A simple modification can change all that.

The various Paper Tiger models produced by Integral Data Systems (IDS) are popular with microcomputer owners because they're rugged, reliable, extremely flexible in operation, and well supported by the manufacturer. That tremendous flexibility, however, is marred by one "bug" in the IDS 460. I use my high-speed printer to generate business

reports (using both single- and multiple-part copy paper), form letters, and address labels. This necessitates a change from thick address labels to thin fanfold paper to single sheets in holders to carbonless multiple-part copy-forms, and back again.

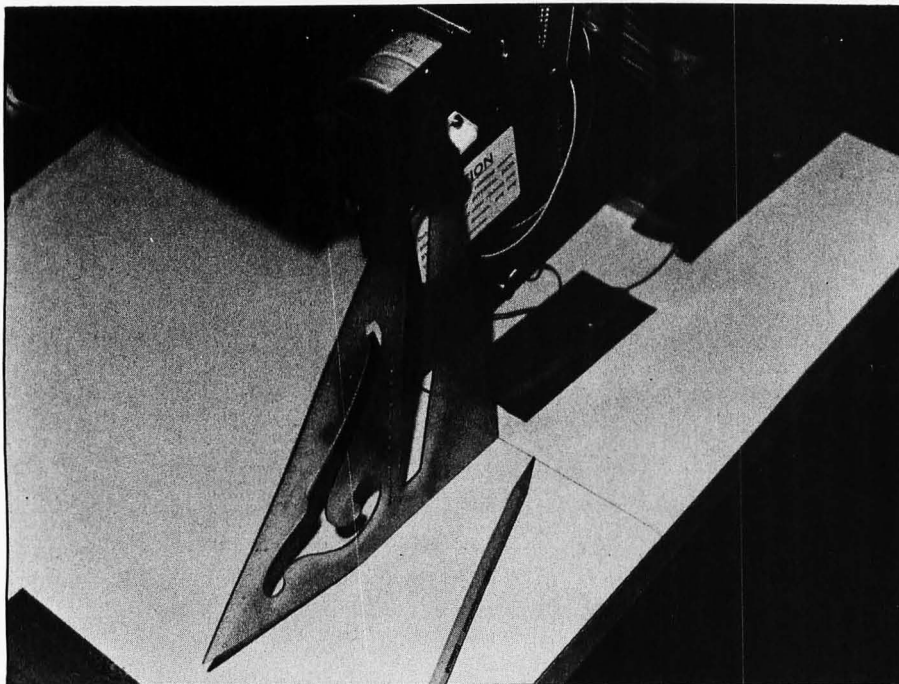
The paper-thickness control knob is located *inside* the cover. In order to adjust it, you must remove the cover, adjust the control, replace the cover (try not to snag the ribbon or damage the circuit board), and then run the printer to see if it's adjusted correctly.

If it isn't, you have to start all over again.

A simple modification solves this problem, making it easy to adjust to the proper paper thickness from *outside* the printer. All you have to do is drill a hole in the cover and cut a slot in the adjusting rod for a screwdriver.

**(Editor's Note:** IDS says that this modification isn't necessary for the newest version of the model 460, as there is a lever attached to the paper-thickness control knob which allows it to be adjusted from outside the printer. You can purchase this lever and knob by contacting Customer Support Group, Integral Data Systems Inc., Milford, NH 03055. If you choose to make the modifications described in this article, IDS says it will still repair its printers no longer under warranty, as long as the printer mechanism itself has not been modified....SJW)

The first step is to locate the position for the hole. Put the printer on a light-colored table or piece of paper and remove the cover. Set a drafting triangle or a small carpenter's square on the table (see photo 1) and make a mark on the table or paper directly below the center of the paper-thickness control knob. Then mark on the triangle the height of the center of the control knob from the table. Without moving the printer, carefully replace the cover. Using the marks on the table and on the triangle, find the spot on the cover where the two marks intersect (see photo 2). Mark



**Photo 1:** Use a square or a drafting triangle to mark the table directly beneath the center of the knob. Measure the height of the shaft above the table and mark the triangle.



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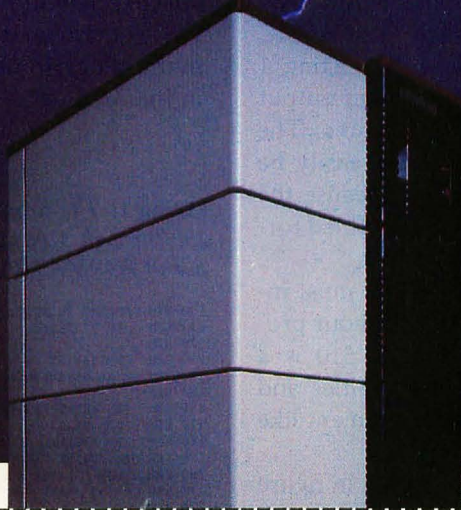
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## BASIC Formatted Printing

Dr. Malladi Subbaiah  
301-46 Caltech  
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How often would you like to have the results of a computation printed in a selected format? Unlike FORTRAN or Extended BASIC, a minimal BASIC such as TI BASIC does not usually have FORMAT statements. Listing 1 shows a routine that I developed to obtain printer output in any desired format with my BASIC programs. The routine, written in TI BASIC (although it can easily be adapted to other BASICs), is simple to use because the PRINT statement can directly access the user-defined format functions without any conditional transfers.

To use the format routine in a program, you must include the statements in lines 230 through 320 in your program before the first PRINT statement. Line 510 is a typical example of such a PRINT statement. Titles and string variables are printed using a PRINT statement like that shown in line 490.

An example of the formatted output is shown in figure 1b. The results would have been printed as in figure 1a if a regular PRINT statement with semicolon print separators (line 470) was used. (Figures 1a and 1b are on page 164.)

The formatting routine takes advantage of the string variables used in TI BASIC. To print a real variable, say X, print the formatted string RF\$(X). Similarly, use IF\$(I) to print an integer, I. To obtain print titles, use RFT\$(X\$) to print X\$ as the title associated with the real numbers. IFT\$(I\$) is a similar function for titles of integer fields. RFT\$(X\$) and IFT\$(I\$) can, of course, be used like RF\$ and IF\$ to print any string variables.

The format field is controlled by the variables FL, FD, and IL (see the DATA statement on line 250). FL and IL represent the total length of the field for real and integer variables, and FD is the number of decimal places chosen for the real numbers. The real numbers are rounded off to the desired digits. (The effect of the two format descriptions is similar to using the FORTRAN statements FORMAT(F FL,FD) for real numbers and FORMAT(I IL) for the integer numbers.)

The program prints right-justified entries in the user-selected field in both real and integer formats. When the value of the variable is larger than can be accommodated in the allocated field, a starred output is printed as shown in figure 1b. ■

**Listing 1:** *The format routine embedded in this program (lines 230 through 320) allows control of printer output without the use of FORMAT statements.*

```
100 REM  FORMAT PRINTING
110 REM  IN TI BASIC
120 REM
130 REM  PROGRAM BY
140 REM  MALLADI SUBBAIAH
150 REM
160 REM  FL- PRINT LENGTH
170 REM  FOR REAL NOS.
180 REM  FD- DECIMAL DIGITS
190 REM  IL- PRINT LENGTH
200 REM  FOR INTEGER NOS.
210 REM  *****
220 REM
230 RESTORE 250
240 READ FL,FD,IL
250 DATA 10,3,6
255 FLD=FL-FD-1
260 BLNK$=""
262 STAR$="" *****
264 DEF C1(X)=INT(((ABS(X)>10^FLD)+(ABS(X)>1E10)-1)/-2)
266 DEF C2(I)=INT(((ABS(I)>10^IL)+(ABS(I)>1E10)-1)/-2)
270 DEF RX$(X)=STR$(X+SGN(X+1E-40)*0.5/10^FD)
295 DEF RF$(X)=SEG$(STAR$&BLNK$&RX$(X),1+(24-FL+POS(RX$(X),".",1)+FD)*(1-C1(X)),
FL)
305 DEF IF$(I)=SEG$(STAR$&BLNK$&STR$(I),1+(24-IL+LEN(STR$(I)))*(1-C2(I)),IL)
310 DEF RFT$(X$)=SEG$(BLNK$&X$&BLNK$,LEN(BLNK$)-(FL-FD-1-LEN(X$)/2),FL)
320 DEF IFT$(I$)=SEG$(BLNK$&I$&BLNK$,LEN(BLNK$)-IL+LEN(I$)+1,IL)
330 REM
340 REM  *****
350 REM  END FORMAT ROUTINE
360 REM
370 DIM M(10),X(10),Y(10),XY(10)
380 READ M(1),M(2),M(3),M(4),M(5),M(6),M(7),M(8),M(9),M(10)
390 READ X(1),X(2),X(3),X(4),X(5),X(6),X(7),X(8),X(9),X(10)
400 READ Y(1),Y(2),Y(3),Y(4),Y(5),Y(6),Y(7),Y(8),Y(9),Y(10)
410 DATA 12,-25,1E12,167,-5.432,29,7618219,14,9527
420 DATA -1.7962,23.95,4741.111111,1E21,1E-14,-0.0265,79830.90145,134.91672,245.
92135,216.9821
430 DATA -2.1,0.97,1.86372,0.01754,7.8924,6.9159,1.15,3.000145,176.36241,213.567
434 N=10
435 U=1
440 OPEN #1:"RS232"
450 FOR I=1 TO N
460 XY(I)=X(I)*Y(I)
470 PRINT #U:;I;M(I);X(I);Y(I);XY(I)
480 NEXT I
490 PRINT #U:;:IFT$(I);IFT$(M(I));RFT$(X(I));RFT$(Y(I));RFT$(X(I)*Y(I))
");:
500 FOR I=1 TO N
510 PRINT #U:IF$(I);IF$(M(I));RF$(X(I));RF$(Y(I));RF$(XY(I))
520 NEXT I
530 CLOSE #1
540 STOP
```



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Circle 177 on inquiry card.



```

1 12 -1.7962 -2.1 3.77202
2 -25 23.95 .97 23.2315
3 1.E+12 4741.111111 1.86372 8836.1036
4 167 1.E+21 .01754 1.754E+19
5 -5 1.E-14 7.8924 7.8924E-14
6 432 -.0265 6.9159 -.18327135
7 29 79830.90145 1.15 91805.53667
8 7618219 134.91672 3.000145 404.7697229
9 14 245.92135 176.36241 43371.28196
10 9527 216.9821 213.567 46340.21615

```

Figure 1a: Sample of printer output from the program in listing 1 without the format routine.

```

I M(I) X(I) Y(I) X(I)*Y(I)
1 12 -1.796 -2.100 3.772
2 -25 23.950 .970 23.232
3 ***** 4741.111 1.864 8836.104
4 167 ***** .018 *****
5 -5 .000 7.892 .000
6 432 -.027 6.916 -.183
7 29 79830.901 1.150 91805.537
8 ***** 134.917 3.000 404.770
9 14 245.921 176.362 43371.282
10 9527 216.982 213.567 46340.216

```

Figure 1b: Using the format routine, the printer output can be formatted to suit your needs. If a number exceeds the length available for a variable, the program in listing 1 will print a string of stars, as shown in lines 3, 4, and 8.

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## Epson MX-80 Print-Control Program for the Apple II

---

Bill Starbuck  
2100 East Edgewood Ave.  
Shorewood, WI 53211

---

How many times have you, after buying a new "toy" for your computer, installed the hardware, read the manual carefully, and played with the equipment until its functions become familiar, only to go back to your regular activities and forget much of what you've learned?

This is what happened after I bought my Epson MX-80 printer. I studied the manual conscientiously and learned all the printer-control codes. For weeks thereafter, I did nothing with the printer except turn it on and off. By the time my Epson Grafrax-80 bit-plot graphics option arrived, I had forgotten how the printer worked.

This time I entrusted the information to the Apple's memory instead of my own. I wrote a print-control program in Applesoft BASIC, called MX-80 (see listing 1), that I keep on disk with my Applewriter text editor.

When the program is run, the screen displays a menu of available printer options (see figure 1). The on-screen display has some of the instruction codes highlighted as black on white. The highlighted options are the choices transmitted to the printer when one of the three termination codes (EDITOR, PRINTER, or QUIT) is entered. To review the inventory of (nongraphics) printer signals, I can choose the INVENT option.

There is no way to query the printer about its current status, so the program records a status file, called MX.STATUS, that recalls the last instructions sent to the printer. This status file is used to initialize the program the next time it is run. The status file is especially conven-

ient when a given typeface is used repeatedly. So that there will be a file for the print-control program to read

*Text continued on page 170*

STANDARD = STANDARD FONT  
ITALIC = ITALIC FONT

STRIKE1 = SINGLE STRIKE  
STRIKE2V = TWO VERTICAL STRIKES  
STRIKE2H = TWO HORIZONTAL STRIKES\*  
STRIKE4 = QUADRUPLE STRIKES\*  
\* ONLY WITH NORMAL LETTERS

SMALL = SMALL LETTERS, UP TO 132/LINE  
NORMAL = NORMAL LETTERS, UP TO 80/LINE

SPACEN = NORMAL SPACING BETWEEN LINES  
SPACET = TIGHT SPACING BETWEEN LINES  
SPACEO = NO SPACE BETWEEN LINES

INVENT = INVENTORY OF MX-80 SIGNALS

EDITOR = SHIFT TO APPLEWRITER'S EDITOR  
PRINTER = SHIFT TO APPLEWRITER'S PRINTER  
QUIT = QUIT

ENTER INSTRUCTION CODE:

**Figure 1:** Menu from the MX-80 print-control program. The menu offers 36 combinations: 24 with normal letters (two fonts by four strikes by three spacings); 12 with small letters (two fonts by two strikes by three spacings). You can also choose INVENT, an inventory of the control signals for the Grafrax-80 function codes, and one of three program-termination options—EDITOR, PRINTER, and QUIT.



# TRS-80\* COMPUTING EDITION

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35 cents

## Percom's DOUBLER II™ tolerates wide variations in media, drives

GARLAND, TEXAS — May 22, 1981 — Harold Mauch, president of Percom Data Company, announced here today that an improved version of the Company's innovative DOUBLER™ adapter, a double-density plug-in module for TRS-80\* Model I computers, is now available.

Reflecting design refinements based on both theoretical analyses and field testing, the DOUBLER II™, so named, permits even greater tolerance in variations among media and drives than the previous design.

Like the original DOUBLER, the DOUBLER II plugs into the drive controller IC socket of a TRS-80 Model I Expansion Interface and permits a user to run either single- or double-density diskettes on a Model I.

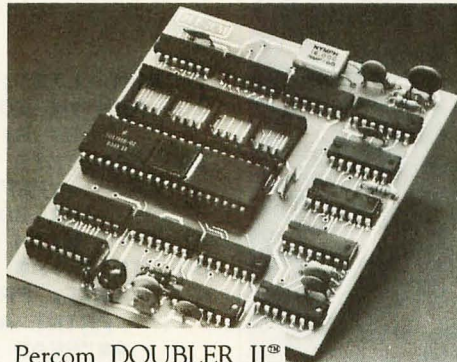
With a DOUBLER II installed, over four times more formatted data — as much as 364 Kbytes — can be stored on one side of a five-inch diskette than can be stored using a standard Tandy Model I drive system.

Moreover, a DOUBLER II equips a Model I with the hardware required to run Model III diskettes.

(Ed. Note: See "OS-80™: Bridging the TRS-80\* software compatibility gap" elsewhere on this page.)

The critical clock-data separation circuitry of the DOUBLER II is a proprietary design called a ROM-programmed digital phase-lock loop data separator.

According to Mauch, this design is more tolerant of differences from diskette to diskette and drive to drive, and also provides immunity to performance degradation caused by circuit component aging.



Percom DOUBLER II™

Mauch said "A DOUBLER II will operate just as reliably two years after it is installed as it will two days after installation."

The digital phase-lock loop also eliminates the need for trimmer adjustments typical of analog phase-lock loop circuits.

"You plug in a Percom DOUBLER II and then forget it," he said.

The DOUBLER II also features a refined Write Precompensation circuit that more effectively minimizes the phenomena of bit- and peak-shifting, a reliability-impairing characteristic of magnetic data recording.

The DOUBLER II, which is fully software compatible with the previous DOUBLER, is supplied with DBLDOS™, a TRSDOS\*-compatible disk operating system.

The DOUBLER II sells for \$219.95, including the DBLDOS diskette.

~~\$219.95~~  
Now \$169.95!

The Percom DOUBLER II is available from authorized Percom retailers, or may be ordered direct from the factory. The factory toll-free order number is 1-800-527-1222.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 309 on inquiry card.

### All that glitters is not gold

#### OS-80™ Bridging the TRS-80\* software compatibility gap

Compatibility between TRS-80\* Model I diskettes and the new Model III is about as genuine as a gold-plated lead Kruggerand.

True, Model I TRSDOS\* diskettes can be read on a Model III. But first they must be converted and re-recorded for Model III operation.

And you cannot write to a Model I TRSDOS\* diskette. Not with a Model III. You cannot add a file. Delete a file. Or in any way modify a Model I TRSDOS diskette with a Model III computer.

Furthermore, your converted TRSDOS diskettes cannot be converted back for Model I operation.

TRSDOS is a one-way street. And there's no re-treating. A point to consider before switching the company's payroll to your new Model III.

Real software compatibility should allow the direct, immediate interchangeability of Model I and Model III diskettes. No read-only limitations, no conversion/re-recording steps and no chance to be left high and dry with Model III diskettes that can't be run on a Model I.

What's the answer? The answer is Percom's OS-80™ family of TRS-80 disk operating systems.

OS-80 programs allow direct, immediate interchangeability of Model I and Model III diskettes.

You can run Model I single-density diskettes on a Model III; install Percom's plug-in DOUBLER™ adapter in your Model I, and you can run double-density Model III diskettes on a Model I.

There's no conversion, no re-recording.

Slip an OS-80 diskette out of your Model I and insert it directly in a Model III.

And vice-versa.

Just have the correct OS-80 disk operating system — OS-80, OS-80D or OS-80/III — in each computer.

Moreover, with OS-80 systems, you can add, delete, and update files. You can read and write diskettes regardless of the system of origin.

OS-80 is the original Percom TRS-80 DOS for BASIC programmers.

Even OS-80 utilities are written in BASIC.

OS-80 is the Percom system about which a user wrote, in Creative Computing magazine, "... the best \$30.00 you will ever spend."

Requiring only seven Kbytes of memory, OS-80 disk operating systems reside completely in RAM. There's no need to dedicate a drive exclusively for a system diskette.

And, unlike TRSDOS, you can work at the track sector level, defining and controlling data formats — in BASIC — to create simple or complex data structures that execute more quickly than TRSDOS files.

The Percom OS-80 DOS supports single-density operation of the Model I computer — price is \$29.95; the OS-80D supports double-density operation of Model I computers equipped with a DOUBLER or DOUBLER II; and, OS-80/III — for the Model III of course — supports both single- and double-density operation. OS-80D and OS-80/III each sell for \$49.95. Circle 310 on inquiry card.

## Circuit misapplication causes diskette read, format problems. High resolution key to reliable data separation

GARLAND, TEXAS — The Percom SEPARATOR™ does very well for the Radio Shack TRS-80\* Model I computer what the Tandy disk controller does poorly at best: reliably separates clock and data signals during disk-read operations.

Unreliable data-clock separation causes format verification failures and repeated read retries.

### CRC ERROR—TRACK LOCKED OUT

The problem is most severe on high-number (high-density) inner file tracks.

As reported earlier, the clock-data separation problem was traced by Percom to misapplication of the internal separator of the 1771 drive controller IC used in the Model I.

The Percom Separator substitutes a high-resolution digital data separator circuit, one which operates at 16 megahertz, for the low-resolution one-megahertz circuit of the Tandy design.

Separator circuits that operate at lower frequencies — for example, two- or four-

megahertz — were found by Percom to provide only marginally improved performance over the original Tandy circuit.

The Percom solution is a simple adapter that plugs into the drive controller of the Expansion Interface (EI).

Not a kit — some vendors supply an untested separator kit of resistors, ICs and other paraphernalia that may be installed by modifying the computer — the Percom SEPARATOR is a fully assembled, fully tested plug-in module.

Installation involves merely plugging the SEPARATOR into the Model I EI disk controller chip socket, and plugging the controller chip into a socket on the SEPARATOR.

The SEPARATOR, which sells for only \$29.95, may be purchased from authorized Percom retailers or ordered directly from the factory. The factory toll-free order number is 1-800-527-1222.

Ed. note: Opening the TRS-80 Expansion Interface may void the Tandy limited 90-day warranty. Circle 308 on inquiry card.

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## System Notes

Listing 1: MX-80, an Applesoft program that controls the print of an Epson MX-80 printer equipped with the Grafrax-80 option.

```

1  REM LISTING 1:
10  REM MX-80
    BY BILL STARBUCK
20  REM THIS PROGRAM SETS THE
    TYPEFACES OF THE EPSON
    MX-80 PRINTER EQUIPPED
    WITH GRAFTRAX-80.
30  TEXT :A$ = CHR$ (4):D$ = CHR$
    (27): PRINT A$"NOMON C,I,O":
    PRINT A$"OPEN MX.STATUS": PRINT
    A$"READ MX.STATUS": INPUT A:
    INPUT B: INPUT C: INPUT D: PRINT
    A$"CLOSE MX.STATUS"
40  PRINT A$"PR# 0": HOME : IF A =
    1 THEN INVERSE
50  PRINT "STANDARD": NORMAL : PRINT
    " = STANDARD FONT": IF A = 2
    THEN INVERSE
60  PRINT "ITALIC": NORMAL : PRINT
    " = ITALIC FONT": PRINT : IF
    B = 1 THEN INVERSE
70  PRINT "STRIKE1": NORMAL : PRINT
    " = SINGLE STRIKE": IF B =
    2 THEN INVERSE
80  PRINT "STRIKE2V": NORMAL : PRINT
    " = TWO VERTICAL STRIKES": IF
    B = 3 THEN INVERSE
90  PRINT "STRIKE2H": NORMAL : PRINT
    " = TWO HORIZONTAL STRIKES*":
    IF B = 4 THEN INVERSE
100 PRINT "STRIKE4": NORMAL : PRINT
    " = QUADRUPLE STRIKES*": PRINT
    TAB( 15)"* ONLY WITH NORMAL
    LETTERS": IF C = 1 THEN INVERSE

110 PRINT "SMALL": NORMAL : PRINT
    " = SMALL LETTERS, UP TO 1
    32/LINE": IF C = 2 THEN INVERSE

120 PRINT "NORMAL": NORMAL : PRINT
    " = NORMAL LETTERS, UP TO 8
    0/LINE": PRINT : IF D = 1 THEN
    INVERSE
130 PRINT "SPACEN": NORMAL : PRINT
    " = NORMAL SPACING BETWEEN
    LINES": IF D = 2 THEN INVERSE

140 PRINT "SPACET": NORMAL : PRINT
    " = TIGHT SPACING BETWEEN L
    INES": IF D = 3 THEN INVERSE

150 PRINT "SPACEO": NORMAL : PRINT
    " = NO SPACE BETWEEN LINES"
    : PRINT : PRINT "INVENT = I
    NVENTORY OF MX-80 SIGNALS": PRINT
    : PRINT "EDITOR = SHIFT TO
    APPLEWRITER'S EDITOR"
160 PRINT "PRINTER = SHIFT TO AP
    PLEWRITER'S PRINTER": PRINT
    "QUIT = QUIT": PRINT : INPUT
  
```



Listing 1 continued:

```

170 IF B$ = "INVENT" GOTO 440
180 IF B$ = "STANDARD" THEN A =
1: GOTO 40
190 IF B$ = "ITALIC" THEN A = 2:
GOTO 40
200 IF B$ = "STRIKE1" THEN B = 1
: GOTO 40
210 IF B$ = "STRIKE2V" THEN B =
2: GOTO 40
220 IF B$ = "STRIKE2H" AND C = 2
THEN B = 3: GOTO 40
230 IF B$ = "STRIKE2H" GOTO 330
240 IF B$ = "STRIKE4" AND C = 2 THEN
B = 4: GOTO 40
250 IF B$ = "STRIKE4" GOTO 330
260 IF B$ = "SPACEN" THEN D = 1:
GOTO 40
270 IF B$ = "SPACET" THEN D = 2:
GOTO 40
280 IF B$ = "SPACE0" THEN D = 3:
GOTO 40
290 IF B$ = "SMALL" AND B > 2 GOTO
330
300 IF B$ = "SMALL" THEN C = 1: GOTO
40
310 IF B$ = "NORMAL" THEN C = 2
GOTO 40
320 GOTO 40
330 HOME : VTAB 12: PRINT "SMALL
LETTERS CANNOT BE": PRINT "
COMBINED WITH TWO HORIZONTAL
STRIKES.": PRINT : GOTO 490

340 PRINT A$"PR# 1": IF D < 3 THEN
PRINT D$; (4 - 2 * D);: GOTO
360
350 PRINT D$; "1";
360 E = 80: IF C = 2 THEN E = 81
370 PRINT D$; CHR$ (84); D$; CHR$
(E): PRINT D$;: IF B < 3 THEN
PRINT CHR$ (70);: GOTO 390

380 PRINT CHR$ (69);
390 PRINT D$;: IF B = 1 OR B = 3
THEN PRINT CHR$ (72);: GOTO
410
400 PRINT CHR$ (71);
410 PRINT D$; (6 - A): PRINT A$"P
R# 0": PRINT A$"OPEN MX.STAT
US": PRINT A$"WRITE MX.STATU
S": PRINT A: PRINT B: PRINT
C: PRINT D: PRINT A$"CLOSE M
X.STATUS": IF B$ = "PRINTER"
THEN PRINT A$"BRUN PRINTER
"

420 IF B$ = "EDITOR" THEN PRINT
A$"BRUN TEDITOR"
430 END
440 HOME : PRINT TAB( 9) "$ DEND
TES CHR$(27)=ESC": PRINT "ST
ANDARD FONT": SPC( 24); "$5":
PRINT "ITALIC FONT": SPC( 2
6); "$4": PRINT "SINGLE STRIK
"ENTER INSTRUCTION CODE: ";
B$: IF B$ = "QUIT" OR B$ = "
PRINTER" OR B$ = "EDITOR" GOTO
340

```

Listing 1 continued on page 170

Circle 409 on inquiry card.

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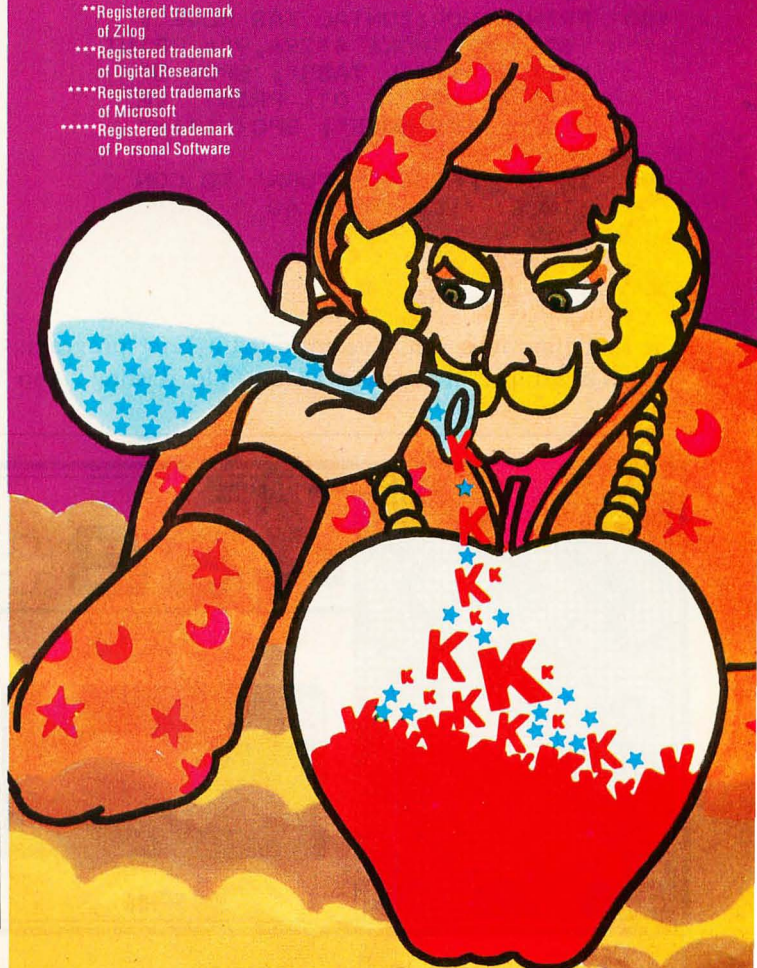
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## System Notes

Listing 1 continued:

```

E"; SPC( 22);"F$H"
450 PRINT "TWO VERTICAL STRIKES"
; SPC( 15);"F$G"; PRINT "TW
O HORIZONTAL STRIKES"; SPC(
13);"H$E"; PRINT "QUADRUPLE
STRIKES"; SPC( 18);"E$G"; PRINT
"SMALL LETTERS (16.5/INCH,13
2/LINE) $T$P"
460 PRINT "NORMAL LETTERS (10/
INCH,80/LINE) $T$Q"; PRINT "
* WIDE LETTERS (8.25/INCH,66
/LINE) $B$P"; PRINT "* DOUBL
E LETTERS (5/INCH,40/LINE)
$Q$B"; PRINT "* RETURN PRINT
HEAD LEFT W/O LINEFEED $<"; PRINT
TAB( 8)* THESE TERMINATE A
T END OF LINE"; PRINT "SPACE
6 LINES/INCH"; SPC( 19);"$2
"
470 PRINT "SPACE 8 LINES/INCH"; SPC(
19);"$0"; PRINT "SPACE #/72
/INCH (0<#<86)"; SPC( 10);"$
A #"; PRINT "SPACE #/216/INC
H (0<#<255)"; SPC( 9);"$3 #
"; PRINT "FORMFEED"; SPC( 23)
;"CHR$(12)"; PRINT "FORM LEN
GTH = # LINES (0<#<256) *
C #"; PRINT "SET HORIZONTAL
TABS"; SPC( 6);"$D #1 #2 ...
0"
480 PRINT "HORIZONTAL TAB MOVE";
SPC( 8);"POKE 49296,9"; PRINT
"SET VERTICAL TABS"; SPC( 8)
;"$B #1 #2 ... 0"; PRINT "VE
RTICAL TAB MOVE"; SPC( 14);"
CHR$(11)"
490 INPUT "PRESS 'RETURN' TO CON
TINUE. ";C$; GOTO 40

```

Text continued from page 166:

the first time it is run, I've included a brief program, shown in listing 2, that creates a status file. (Listing 2 also

Listing 2: This program creates a disk file, called MX.STATUS, that is accessed by the program in listing 1. You must run this short program prior to running the MX-80 printer program for the first time.

```

10 REM THIS PROGRAM CREATES
A FILE, MX.STATUS, OF
PARAMETERS THAT ARE
USED BY THE MX-80
PROGRAM.
20 A = 1:A$ = CHR$(4): PRINT A$
"OPEN MX.STATUS": PRINT A$"W
RITE MX.STATUS": PRINT A: PRINT
A: PRINT A: PRINT A: PRINT A
$"CLOSE MX.STATUS"

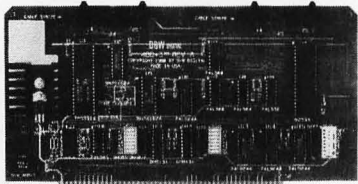
```

shows the italic font that is available with the Grafrax-80.)

The print-control program is designed for the Applewriter word processor, but can be adapted to other text editors by modifying lines 150, 160, 410, and 420. To use the program with Applewriter:

1. Enter S to save the text file.
2. Enter Q to quit Applewriter.
3. Enter RUN MX-80.
4. Turn on the printer.
5. Enter choices from the menu.
6. Enter Printer to quit the MX-80 program.
7. Enter L to load the text file.
8. Enter P to print.

Do not turn the printer off between running the print-control program and the actual printing because your choices will be lost as the printer resets to its default options (STANDARD, STRIKE1, NORMAL, SPACEN). You may switch the printer offline and manually advance the paper by pressing the formfeed or linefeed buttons without affecting the typeface settings. ■



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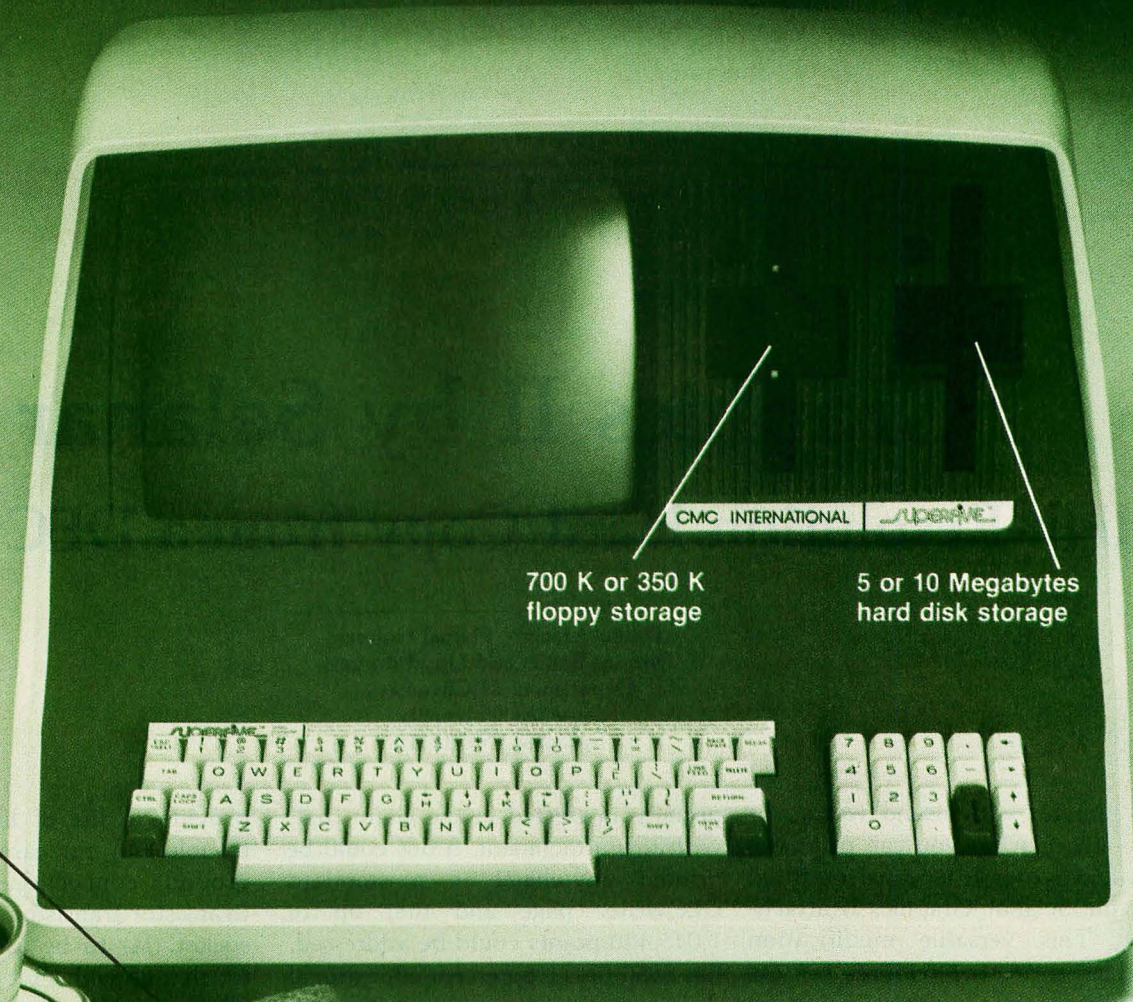
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## Graphics II by Selanar

### High-Resolution Hard Copy from a DECwriter

---

Daniel Macero, Daniel Holmes  
Thomas Banks and Lloyd Burgess  
Department of Chemistry  
Syracuse University  
Syracuse, NY 13210

---

A picture, a thousand words, or both—that's what you can print out on a DECwriter II terminal outfitted with the Selanar Graphics II attachment. This versatile modification provides a host of features for the DECwriter (by Digital Equipment Corporation): high-resolution graphics, bidirectional linefeed, multiple character sets, the ability to print standard, boldface, and double-width characters that can be rotated in any one of four directions, and several other useful options that cost extra if purchased from DEC.

Our interest in this unit began when we saw it featured in the new-products section of a digital-electronics trade magazine. We were es-

pecially interested in the claim that, with this attachment, a dot could be printed anywhere on a standard DECwriter page and that up to 1,045,440 points could be addressed. For \$850 (less a 5 percent educational discount), this seemed like a low-cost way to high-resolution graphics, so we ordered a Graphics II modification from Selanar Corporation.

In less than three weeks the unit arrived. The box contained the Graphics II circuit board, a power cable consisting of three wires: blue, black, and orange (the same color-coding used by DEC), six #8 nylon screws and nylon washers (already attached to the circuit board), and a user's manual.

#### Installation and Testing

With the help of the user's manual, installing the Graphics II board was simple and straightforward. First, we examined the board for any damaged or loose components. (The manual

provides a list of likely sources of trouble.) In our case, we found the ground connection of the TTL (transistor-transistor logic) interface socket (J4) to be loose and had to touch it up with a bit of solder; otherwise, everything was in order.

Next, the board was prepared for installation by selecting from the several available jumper options (i.e., parity, bell, serial interface, and data-transfer rate). Step-by-step instructions are accompanied by two full-page photographs that show the inside of the DECwriter before and after installation of the Graphics II board. The photos are invaluable for locating and identifying the various components important to the installation.

Following the instructions given in the user's manual, the original DECwriter board was removed. (A screwdriver is all that is necessary for this and the following operations.) The Graphics II board was attached to the

---

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---

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six mounting points on the DECwriter back panel using the attached nylon hardware. The cables provided with the DECwriter were then connected to the new circuit board and the three-wire cable was connected to

the terminal's power supply. This completed the assembly of the unit.

Sufficient warnings are included at each step to insure a virtually foolproof installation. Total installation time was about 30 minutes. After verifying that all connectors to the Graphics II board and all components on the board were secure, and that there were no loose parts, tools, or other items left on the circuit board or in the internal cabinet area of the terminal, the unit was ready for testing.

The testing procedure is straightforward and can be done without sophisticated test equipment. By switching the DECwriter to local operation, the user can run through the various features, including graphics, and verify that everything is working properly. Once everything is operational, the I/O (input/output) interface is checked and the printer is ready to use.

## Printer Adjustment

Our unit worked immediately and we were soon printing out the different character sets in boldface and double-width; however, some characters did not seem well formed. In addition, the tractor drive had a tendency to slip. The character problem, we were told, was caused by minor variations in parts such as the drive and stepper motors used in different DECwriters; this can result in different levels of performance depending on the user's specific terminal. To compensate for these variations, the Graphics II unit has built-in adjustments that can be set to obtain optimum performance. An oscilloscope, preferably one with dual-trace capability, is necessary for making these adjustments. The procedure outlined in the user's manual gives two types of adjustments: print columns and print-speed control. In our case, we simply adjusted the forward and reverse print-speed controls and the characters printed out perfectly.

In operation, the enhanced DECwriter can function as an unmodified terminal, as a terminal featuring many of the options offered by DEC at extra cost, and in the graphics mode (a completely new feature). System commands are selected by

## At a Glance

### Name

Graphics II

### Use

Enhancement to the DECwriter II printer

### Manufacturer

Selamar Corporation  
3054 Lawrence Expressway  
Santa Clara, CA 95051

### Dimensions

48.3 x 26.7 cm (19 x  
10.5 inches)

### Price

\$895

### Hardware Needed

DECwriter LA35 or DECwriter LA36

### Software Needed

None

### Hardware Options

Precision tractors, \$50 extra

### Documentation

50-page manual, includes schematics

### Audience

DECwriter owners desiring high-resolution  
hard-copy graphics

### Features

Print speed: character mode, average 36 cps—graphics mode, average 1 ips;  
transmission rates: selectable to 1200 bps, with X-on and X-off; interfaces: 20 mA current loop, EIA RS232, TTL (for modem); line length: character mode, 132 characters—graphics mode, 1320 dots; spacing: character mode, horizontal, 10 cpi—vertical, 6 lpi; graphics mode: horizontal, 100 dots per inch—vertical, 72 dots per inch; four complete character sets including uppercase and lowercase: ASCII character set, APL character set, Math/Greek character set, user-defined character set (load from keyboard or computer into memory); boldface: all characters; four rotations: all characters; double width: all characters

### Paper

Variable width 7.6 cm (3 inches) to 37.8 cm (14 7/8 inches); up to 6-part forms 0.020 in maximum thickness; tractor-drive line feed

### Power Requirements

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Control Code	Name	Description
cL	Form feed	Advance paper to beginning of next form (top of page).
cN	APL character set	Selects second character set (factory set with APL characters). Once selected, all characters printed are as defined from this PROM.
cO	Normal character set	Selects normal character set.
ESC 5	Print entire character set	Test mode.
ESC 7	Upside-down print mode	Rotates characters 180°.
ESC 8	Sideways I print mode	Rotates characters 90°.
ESC 9	Sideways II print mode	Rotates characters 270°.
ESC 0	Double-width characters	Prints double-width characters.
ESC A	Boldface characters	Prints each character in boldface.
ESC C	Special reset	Returns DECwriter to normal configuration.
ESC F	Power-up reset	Resets all modes, character styles, tabs, and top of form (also occurs at power-up).
ESC G	Up 1/4 line	Moves paper up 1/4 line at a time.
ESC H	Down 1/4 line	Moves paper down 1/4 line at a time.
ESC N	Third character set	Selects third character set (factory set for mathematics symbols and selected Greek letters).
ESC P	Fourth character set	Selects fourth character set as defined in programmable memory.
ESC Q	Load-memory character set	Defines fourth character set to be loaded into programmable memory.
ESC B	Enter graphics mode	Enters graphics mode. All characters ignored except "(", ")", ":", "]", and digits 0 through 9.
ESC J	Set bar mode	In graphics mode, prints all seven dots instead of one at a time.
ESC C	Exit graphics mode	

**Table 1:** Command codes used by the LA36 DECwriter II with the Selanar Graphics II modification. Codes in the table preceded by a lowercase "c" are entered by holding down the Control key while entering the indicated code (similar to the standard procedure for typing any uppercase letter by using the shift key). Other codes are entered by typing ESC (escape) followed by the indicated letter.

either a Control code or an ESC (escape) code. The Control code is obtained by simultaneously pressing the Control key and another key to select a given function. The ESC code is a two-step operation: first the ESC key is pressed, then the key that selects the desired function. Pressing ESC a second time cancels this command sequence. Table 1 is a list of some of the more important ESC and Control commands that function in the normal (nongraphics) and graphics modes.

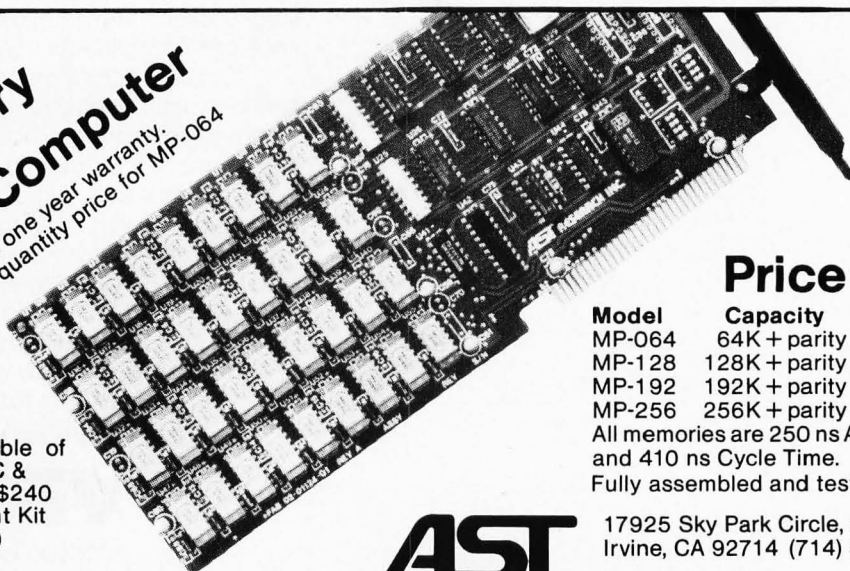
Other system commands that can be implemented with Graphics II are horizontal tab control (advances the print head to the next column position with a set tab); vertical tab (advances the paper vertically to the next line with a vertical tab); set horizontal tab (sets a tab where the head is positioned, up to 16 tabs may be set); reset horizontal tab (resets the individual horizontal tabs at each desired head position); set vertical tab (sets a tab to any one or all of 16 vertical tab positions); and reset vertical tab (resets an individual vertical tab at the present position of the print head).

In addition, you can activate the bell, reset the top-of-form position, enable the automatic linefeed with carriage return, backspace, and issue a special *Here-is* message where up to

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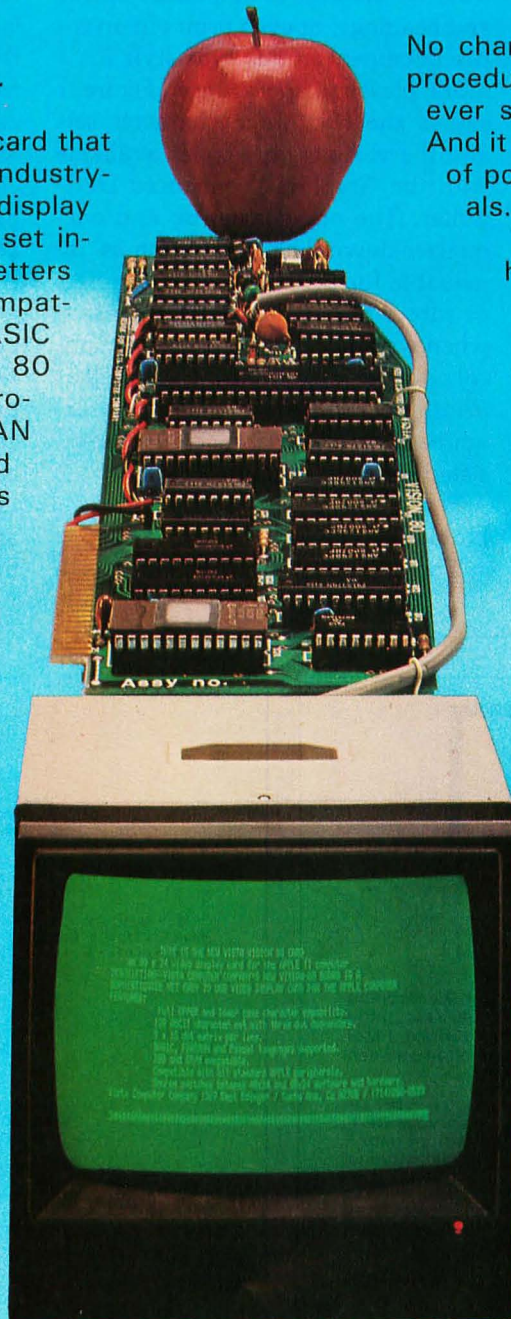
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32 characters encoded in PROM (programmable read-only memory) are transmitted as if from the keyboard (e.g., for an automatic password sign-on to a remote computer).

### "Normal" Printing Operations

In the printing mode the Selanar Graphics II acts as a normal DEC-writer printer with enhanced capabilities. We can select any one of four character sets: standard, APL, mathematical, and user-defined. The first three sets are encoded in PROM, the fourth is stored in programmable memory. The fourth character set may be loaded from the host computer or entered manually from the keyboard; once loaded, it remains in memory until the DECwriter is turned off.

The programmable character set can contain up to 94 printable characters. Each of these is represented as a 7-by-7 dot matrix with the top dot corresponding to the most significant bit and the bottom dot to the least.

Seven bytes are required to define each character: one for each column of the matrix. For convenience in entering characters from the keyboard, each byte can be entered as an ASCII (American Standard Code for Information Interchange) character.

Using the boldface character option, we are able to emphasize words and headings, or even print out an entire document in this type style for a more pleasing appearance. Figure 1 shows the first three character sets and the various type styles available with the Graphics II enhanced DEC-writer. The one-quarter-up and one-quarter-down linefeed option is invaluable for printing the superscripts or subscripts that are often necessary when writing chemical or mathematical equations (see figure 1), as well as printing chemistry manuscripts, examinations, and writing computer-assisted instruction units.

### Data Buffer

The Graphics II unit also has a

1000-character buffer for serial I/O. In this mode, the printer will automatically print characters as fast as it can. Data not ready for printing will be temporarily stored in the buffer; however, the programmer must be careful not to overflow the buffer. To prevent this, an X-off character is sent to the host computer when the buffer is filled to within 100 bytes of overflow; an X-off character is then sent for every additional character received. When the buffer is emptied to fewer than 100 characters, an X-on character is transmitted. Thus, the programmer does not have to worry about overflowing the buffer or other timing considerations, and data transfer rates of up to 1200 bps (bits per second) are possible. The X-on/X-off option need not be used if the programmer is careful to take into account the time needed to execute a carriage return and line feed, horizontal tab, vertical tab, graphic vectors, and Here Is, to avoid overflowing the buffer.

## GRAPHICS II CHARACTER SETS

### STANDARD

```
! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~

! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~
```

### MATHEMATICS

```
! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~
```

### APL

```
! " # $ % & ' ( ) * + , - . / 0 1 2 3 4 5 6 7 8 9 : ; < = > ?
@ A B C D E F G H I J K L M N O P Q R S T U V W X Y Z [ \ ] ^ _
` a b c d e f g h i j k l m n o p q r s t u v w x y z { | } ~
```

### CHEMICAL EQUATIONS

(2)  $\text{Cu}^{2+} + 2\text{e}^{-} \rightarrow \text{Cu(s)} + \text{Cl}_2\text{(g)}$

Figure 1: The character sets and type styles preprogrammed into the Graphics II modification. Under the Normal printing mode, subscripts and superscripts can be printed easily with the 1/4 linefeed capability, and characters may be printed as boldface, large, or double width.



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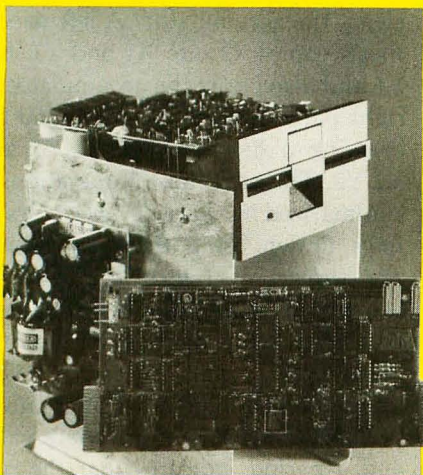
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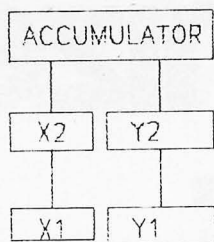
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(2a)

## THE GRAPHICS MODE



### GRAPHICS COMMANDS

- ( X2 TO X1, Y2 TO Y1,  
CLEAR ACCUMULATOR
- , ACCUMULATOR TO X2, AND CLEAR
- . ACCUMULATOR TO Y2, AND CLEAR
- ) DRAW LINE FROM X1,Y1 TO X2,Y2
- POSITION PRINT HEAD TO X1,Y1

(2b)

### EXAMPLES USING GRAPHICS COMMANDS

LOCAL - (800,200.(900,)(1000,150.)

BASIC - LPRINT "(";STR\$(800);",";STR\$(200);".(";STR\$(900);  
",)(;STR\$(1000);",";STR\$(150);")"

LOCAL - (900,500.(1000,450.)800,450.)800,550.)1000,550.)



**Figure 2:** Graphics-mode sample output. Figure 2a gives a summary of the graphics command procedures, as printed in the graphics mode. Figure 2b shows how straight lines are drawn.

### Graphics Operation

The graphics mode is entered at any time with an ESC B and exited with a ESC C command. Graphics are done a page at a time, with each page consisting of 792 lines with 1320 dots per line. The origin (0,0) is located at the upper left-hand corner of the page; the bottommost right-hand corner corresponds to the point (1319,791).

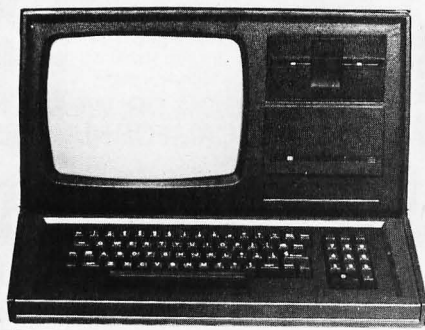
In the graphics mode, the system responds only to the digits 0 through 9, parentheses, the right bracket, the comma, and the period; all other characters are ignored.

The comma transfers the previously entered number from the accumulator to the X2 register and then clears the accumulator. A left parenthesis copies X2 into X1 and Y2 into Y1 and also clears the accumulator; a right parenthesis is the command for drawing a line between X1,Y1 and X2,Y2. This sequence of operations is summarized in figure 2a. Examples of lines drawn using these commands are shown in figure 2b. Also illustrated is a BASIC print statement that shows the method of drawing lines under program control. Note that a comma indicates that the number preceding it is an ordinate value and a period indicates that the preceding number represents an abscissa.

Thus, (A,B.(C,D.) will draw a line between A,B and C,D; (A,B.(C.) draws a horizontal line between A,B

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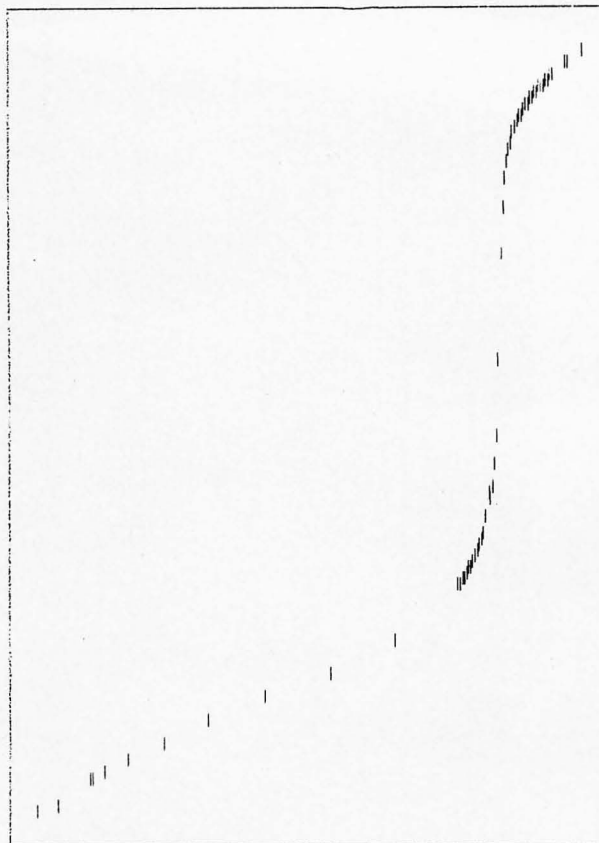
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INSTRUMENTAL METHODS, CHEM. 434/5

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VOLUME TITRANT ADDED

Figure 3: Typical acid/base titration curve. Data points are drawn as short bars, the curve is enclosed by a border, and the heading and labels are printed double width.

and C,B; (A,B.(.) prints a single dot; and the right bracket, as in A,B.(], positions the print head at location A,B without printing. Two examples are illustrated in figure 2b where, in the top example, a horizontal line is drawn between the points 800,200 and 900,200 and then a line from 900,200 to 1000,150. The intersecting lines in the bottom example are drawn in the same manner. First, a line is drawn between the points 900,500 and 1000,450; then a line between 900,500 and 800,450; a line between 900,500 and 800,550; and finally, a line between 900,500 and 1000,550.

### The Use of Precision Tractors

Another modification of the DEC-writer, which is particularly useful in graphics mode, is the installation of a set of precision paper-feed tractors in place of the standard tractors supplied with a conventional DECwriter. (These can be obtained from the Selanar Corporation for \$50.) Their purpose is to insure that lines originating from the same point (such as in a radial pattern) begin at that point every time a new line is drawn—otherwise the pattern shows a distinct discontinuity. The improvement in the printed results due to the use of the precision tractors can be seen in





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(4a)

## EXAMPLES OF PERSHEY CHARACTER ALPHABETS

ABCDEFGHIJ

ABCDEFGHIJ

abcdefghij

ABCDEFGHIJ

ABCDEFGHIJ

ABCDEFGHIJ

abcdefghij

(4b)

HEPSTW< 0Z8VU0T0C8P8U 00Y80P 00Y80P

USE A 2-D ROTATIONAL ALGORITHM

$$\begin{vmatrix} X_1 & Y_1 & 1 \\ X_2 & Y_2 & 1 \\ X_H & Y_H & 1 \end{vmatrix} * \begin{vmatrix} \cos(Q) & -\sin(Q) & 0 \\ \sin(Q) & \cos(Q) & 0 \\ 0 & 0 & 0 \end{vmatrix} = \begin{vmatrix} X_1 & Y_1 & - \\ X_2 & Y_2 & - \\ X_H & Y_H & - \end{vmatrix}$$

EXAMPLES

SIXTY

WRE

ABC

BTE

Syracuse

Figure 4: Various type fonts produced by the program of listing 1 from data stored on disk. The rotation feature is shown in figure 4b.

figure 2b, where the lines all originate from the point 900,500. The precision tractors are no trouble to install and otherwise perform exactly like the original tractors.

Figure 3 shows a typical acid/base titration curve. Note the use of the double-width characters to label the graph, the box enclosing the curve, and the use of the bar-print mode to emphasize the individual data points. This graph was generated with a FORTRAN program and is a good example of the combined use of printing characters and graphics. The four character sets, double-width, bold-face, and character rotation options all make the Selanar Graphics II board a powerful addition to any DECwriter.

### Generating Character Sets

The excellent resolution available with the Graphics II and the fact that it prints vector-generated graphics prompted us to explore the use of graphics to draw characters as well as plot curves. Normally, we would have to do this by developing tables of coordinates for each alphanumeric character. But fortunately, there is an invaluable reference work that provides all the information needed: *A Contribution to Computer Typesetting Techniques: Tables of Coordinates from Hershey's Repertory of Occidental Type Fonts and Graphic Symbols*. (Published by the U.S. Department of Commerce, the book is now out of print, although many libraries have a copy.)

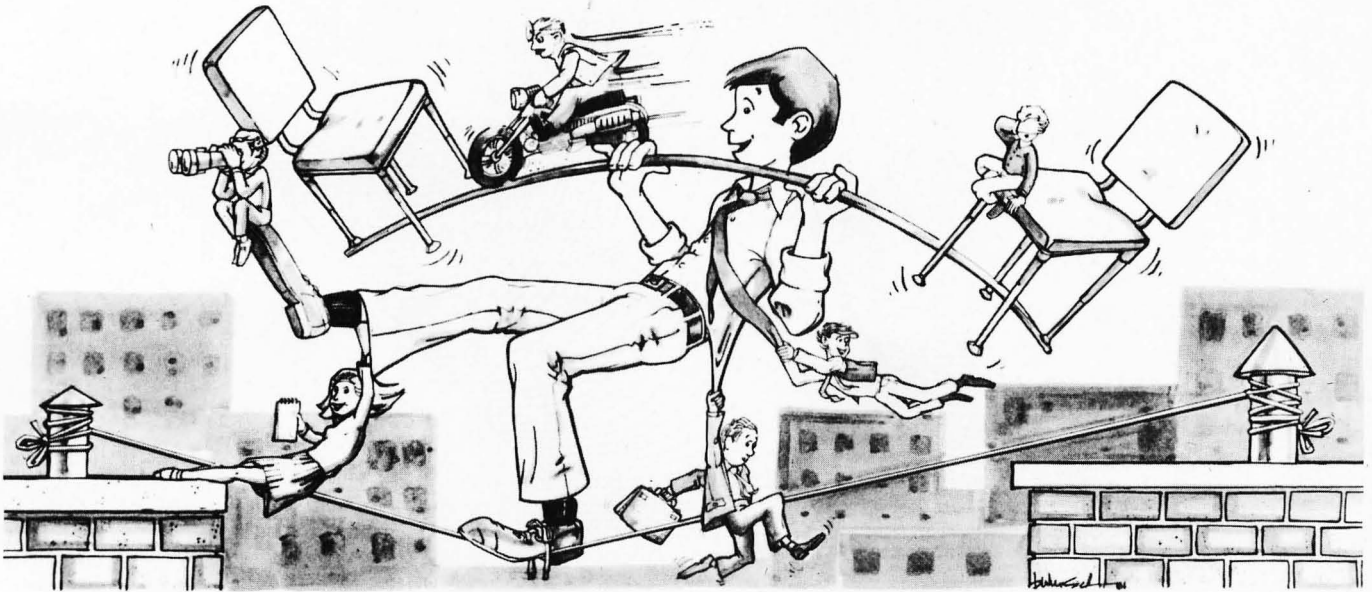
This document lists the coordinates used to generate 1377 different alphabetic and graphic characters on either a video terminal or a hard-copy digital plotter. The tables were originally developed by Dr. A. V. Hershey of the Naval Weapons Laboratory in Dahlgren, Virginia. Dr. Hershey's assiduous digitization of these many character sets and symbols is as much a work of art as it is a scientific achievement, and it includes symbols from mathematics, engineering, music, and other disciplines. The typeset quality of the characters and symbols is certain to enhance any graphics display.

Figure 4a presents several examples

Text continued on page 196



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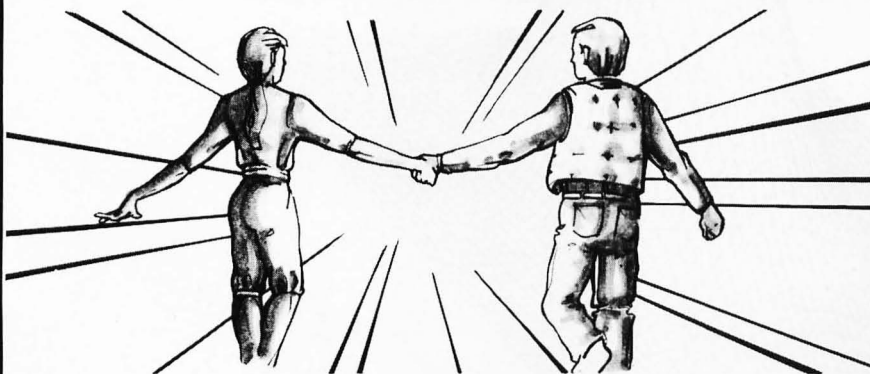
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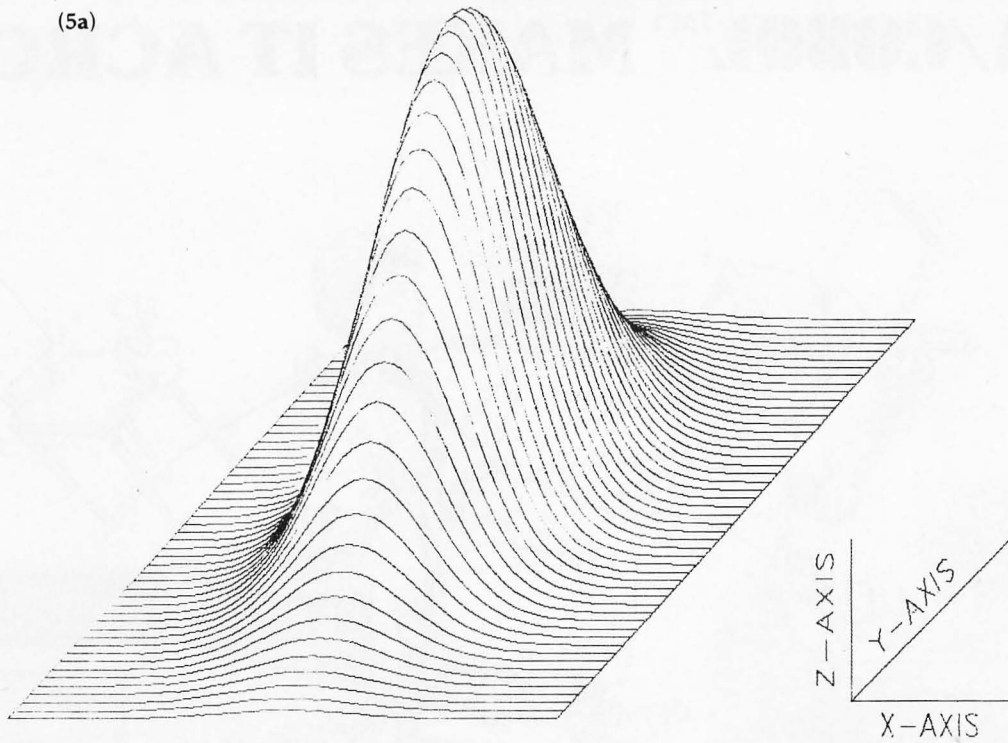
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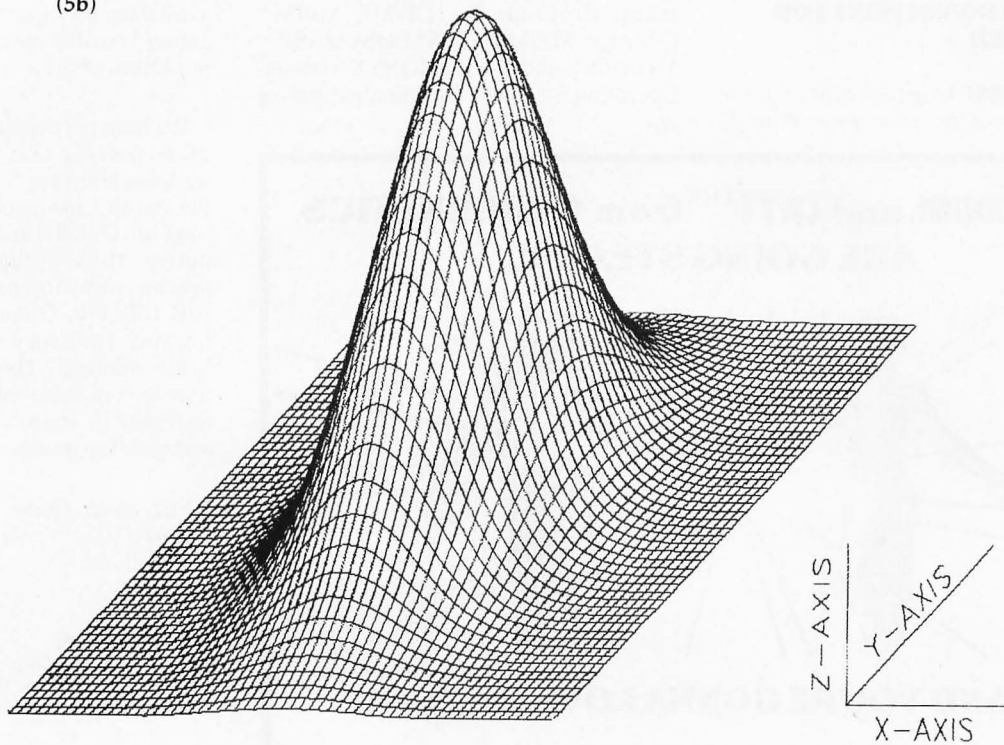


(5a)



PLOT OF  $\text{EXP}(-(X^2+Y^2))$

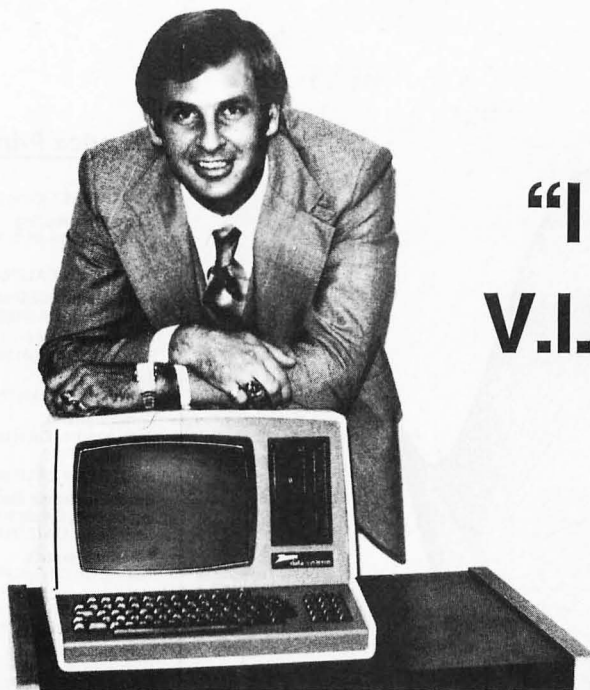
(5b)



PLOT OF  $\text{EXP}(-(X^2+Y^2))$   
USING CROSS-HATCHING

**Figure 5:** Three-dimensional plotting in the graphics mode. Figures 5a and 5b show the same function but with differing detail; figure 5c (on page 190) is a "two-dimensional particle in a box."





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TS-802 Comput/Terminal	3495	2795
TS-802H Comput/Terminal	6995	5595
TS-806 Multi User Proc.	7195	5749



### TELETYPE TERMINALS

	List	Sell
910 Terminal	699	.575
912 Terminal	925	659
920 Terminal	995	725
925 Terminal	995	750
950 Terminal	1195	900



### NEC PRINTERS

	List	Sell
3510-1 30CPS Serial	2450	2050
7710-1 55CPS Serial	CALL	CALL
7720-1 KSR Serial	CALL	CALL
Forms Tractors	CALL	CALL



### NORTHSTAR HORIZON PRODUCTS

	List	Sell
HRZ-20-64K	4495	3149
HRZ-10-64K-HD5	5695	4999
HRZ-10-64K-HD18	9270	6749

NorthStar is discontinuing many of their horizon products. Call for availability and price of any product not listed.



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	List	Sell
Northword D/Q	399	295
Mailmanager D/Q	299	235
Informanet D/Q	499	365
General Ledger D/Q	599	475
A/R D/Q	599	475
A/P D/Q	599	475



### TEXAS INSTRUMENTS PRINTERS

	List	Sell
TI-810 BASIC	1645	1398
TI-810 Full ASCII	1745	1479
TI-810 Package	1945	1649
TI-820 R/O BASIC	1995	1625
TI-820 KSR Package	2395	1950



### NORTHSTAR ADVANTAGE COMPUTER

	List	Sell
ADV-20-64K	3995	CALL
SIO Board	175	CALL
PIO Board	200	CALL
FPB Board	399	CALL
Graphics Option	299	CALL



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	List	Sell
Cat Modem	189	140
D-Cat	199	150
Auto-Cat	249	190
Apple-Cat	389	310
DC Hayes Micro-100	379	330
DC Hayes Smart Modem	279	240



### EPSON PRINTERS

	List	Sell
MX-80	645	CALL
MX-80 FT	745	CALL
MX-100	995	CALL

Call for pricing on interfaces and cables



### MORROW DECISION COMPUTER

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Decision 1 BASIC	1725	1350
Decision 2	CALL	CALL
65 K Static Ram	1000	780
Switchboard I/O	259	210

Select drives from Morrow disc systems for desired configuration.



### MORROW DISC SYSTEMS

	List	Sell
Discus 2D 1 Drive	1095	849
Discus 2D 2 Drive	1875	1389
Discus 2 + 2 1 Drive	1395	1075
Discus 2 + 2 2 Drive	2495	1859
M26 Hard Disc	4495	3395

CP/M & Microsoft Basic Included



### LINE PRINTERS

	List	Sell
Okidata 82A	719	550
Okidata 83A	1195	899
Anadex 9500	1650	1285
Anadex 9501	1650	1285



### SYSTEMS GROUP

	List	Sell
2600 Computer	5035	3595
DM-6400 Memory	760	585
DMB-6400 Memory	995	735
CPC-2813 CPU + I/O	460	365
FDC-2801 Controller	465	370



### MICROPRO SOFTWARE

	List	Sell
Wordstar	495	330
Apple Wordstar	375	275
Spellstar	250	190
Mailmerge	150	100
Datatar	350	250
Supersort	250	190



### DISC CABLES

	List	Sell
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Memorex 5" 2D	55	36
Verbatim 5" 1D	40	30
Verbatim 5" 2D	55	45
RS-235 5" Cable	30	20
RS-232 10" Cable	40	25

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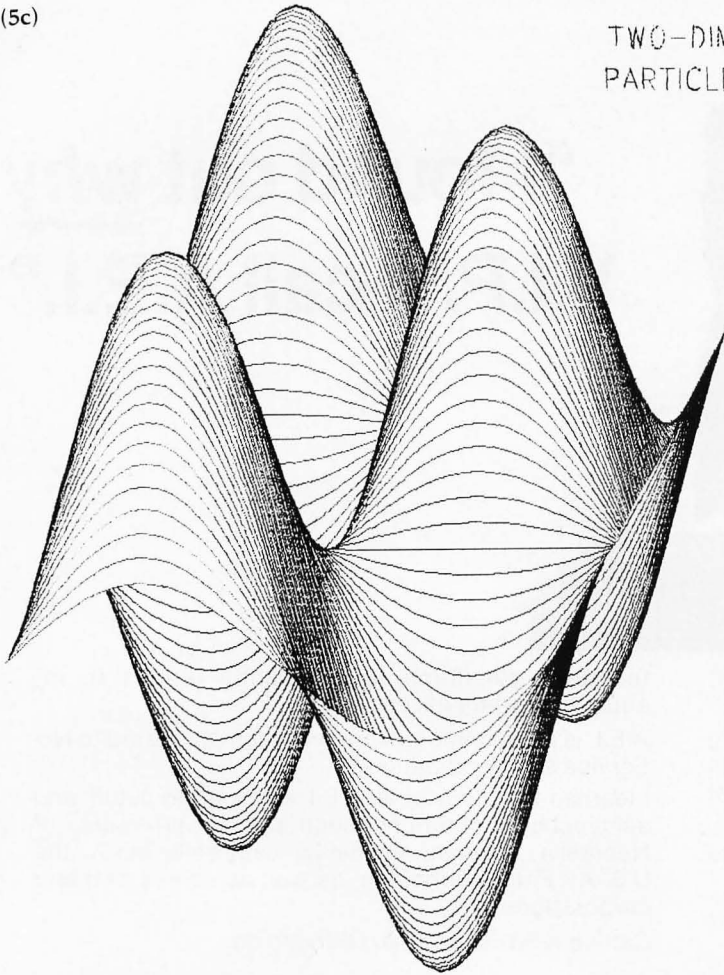
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Calif. and International  
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Out of State  
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# TWO-DIMENSIONAL PARTICLE IN A BOX



Listing 1: Program used to print characters in the various type fonts from data stored on disk. The program (written in Microsoft BASIC-80, Version 5.0) produces output, such as that shown in the figures, on the modified DECwriter.

```

10 REM *****
15 REM *
16 REM *          DANIEL S. HOLMES          *
17 REM *          CHEMISTRY DEPARTMENT      *
18 REM *          SYRACUSE UNIVERSITY       *
21 REM *
22 REM *****
30 REM THIS PROGRAM OUTPUTS ANY OF A NUMBER OF HERSHEY
32 REM CHARACTERS AS TEXT. THE TEXT AND NUMBER OF LINES
34 REM ARE USER SELECTED, ALONG WITH THE MAGNIFICATION
36 REM FACTOR, AND THE ANGLE OF ROTATION (0-360 DEGREES).
38 REM
40 REM
42 REM ENTER GRAPHICS MODE
44 LPRINT CHR$(27); "B"
46 REM
47 REM THIS PART OF THE PROGRAM IS TO INPUT ALL USER SELECTED DATA
48 REM
50 DIM X$(10,100),A$(250),A(250), S(3,120),Q(3,120)
70 PRINT " CHARACTER SETS"
80 PRINT "CROMAN"
90 PRINT "SIMSCRIPT"
100 PRINT "COMITPRN"
110 PRINT "TROMAN3"
120 PRINT "GOTHICENG4"
130 PRINT "LCGOTH3"
140 PRINT:PRINT:INPUT "WHICH CHARACTER SET DO YOU WANT ";C$
150 OPEN "R",1,C$
160 PRINT : INPUT "# RECORDS / CHARACTER ";REC
190 PRINT
200 PRINT "          ENTER TEXT":PRINT
210 INPUT "# OF LINES (UP TO TEN) ";Q2

```

Listing 1 continued on page 192

## Anadex Printer Distributors

### NORTHWEST (Oregon, Washington, W. Idaho)

**Sigma Distributing**  
Bellevue, WA (206) 454-6307

### NORTHERN CALIFORNIA

**Basic Electronic Distributors**  
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**Terminal Rentals**  
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**Byte Industries**  
Hayward, CA (415) 783-8272

**Computerland**  
San Leandro, CA (415) 895-9363

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Inglewood, CA (213) 673-4300;  
San Diego, CA (714) 268-8000

**Terminal Rentals**  
Tustin, CA (714) 832-2414

### SOUTHWEST

(Texas, Oklahoma, Arkansas, W. Louisiana)

**Barnhill Associates, Inc.**  
Richardson, TX (214) 231-2573;  
Houston, TX (713) 688-9971; Austin, TX (512) 451-0217

**ROCKY MOUNTAIN STATES** (Colorado, Wyoming,  
Montana, Utah, E. Idaho, Arizona, New Mexico)

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Albuquerque, NM (505) 299-7658;  
Murray, UT (801) 262-3000

**MIDWEST** (Illinois, Missouri, Kansas, Nebraska,  
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Iowa, Wisconsin)

**Tek-Aids, Inc.**  
Arlington Heights, IL (312) 870-7400

**Comtel Corporation**  
Chicago, IL (312) 539-4838; St. Louis, MO (314) 428-5508;  
Shawnee Mission, KS (913) 722-1030; Minneapolis, MN  
(612) 835-3060; Indianapolis, IN (317) 253-1681;  
Cedar Rapids, IA (319) 377-9434;  
Brookfield, WI (414) 786-1940

**NORTHEAST** (Connecticut, Vermont, Massachusetts,  
Maine, Rhode Island, New Hampshire)

**Pat Jenks Associates**  
North Haven, CT (203) 239-6201;  
Woburn, MA (617) 938-0488

**Microamerica Distributors**  
Needham, MA (617) 449-4310

### NEW YORK METROPOLITAN AREA

**Logon, Inc.**  
Fort Lee, NJ (201) 224-6911 / (212) 594-8202

**MID-ATLANTIC STATES** (Maryland, Washington, DC,  
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**Micro Distributors, Inc.**  
Rockville, MD (301) 468-6450  
Plymouth Meeting, PA (215) 265-1600

**SOUTHEAST STATES** (Louisiana, Florida, Alabama,  
Mississippi, Georgia, N. Carolina, S. Carolina)

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Orlando, FLA (305) 855-0843;  
Greensboro, NC (919) 273-3040

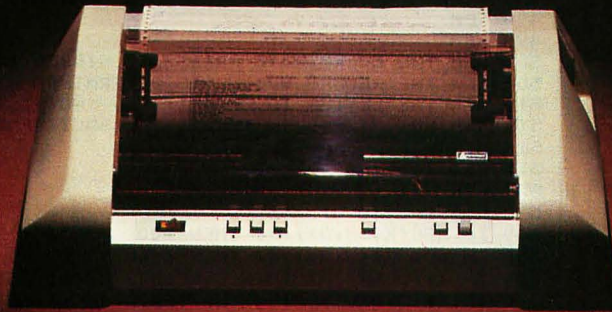
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The full standard ASCII 96 character set, with descenders and underlining of all upper and lower case letters, is printed bi-directionally, with up to 5 crisp copies, at speeds up to 200 CPS. Models DP-9500 and DP-9501 offer 132/158/176 and 132/165/198/220 columns respectively. Print densities are switch- or data-source selectable from 10 to 16.7 characters/inch. All characters can be printed double-width under communications command.

#### Interface Plus

Standard in all models are the three ASCII compatible interfaces (Parallel, RS-232-C, and Current Loop). Also standard is a sophisticated communications interface to control Vertical Spacing, Form Length and Width, Skip-Over Perforation, Auto Line Feed, X-On/Off, and full point-to-point communications.

#### Features Plus

As standard, each model features forms width adjustment from 1.75 to 15.6 inches, shortest-distance sensing, full self-test, 700 character FIFO buffer (with an additional 2048 characters, optional), and a quick-change, 6 million character life ribbon.

#### Quality Plus

Beyond the built-in performance of the grafixPLUS series printers, the engineered-in quality and support are equally important. The result? Approval of both UL and FCC, Class A; operating noise levels under 65dba; and a nationwide service organization second to none.

To see for yourself why the grafixPLUS printers offer more pluses for your printing dollar, contact us today.



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The **ETI<sup>2</sup>** is no simple black box, either. It is a sophisticated micro-computer with 2000



characters of memory, over 39 special commands and the option of doing typesetting on the IBM Model 50.

Write or Call

## MEDIAMIX

P.O. Box 67B57  
Los Angeles, California 90067  
(213)475-9949

Listing 1 continued:

```

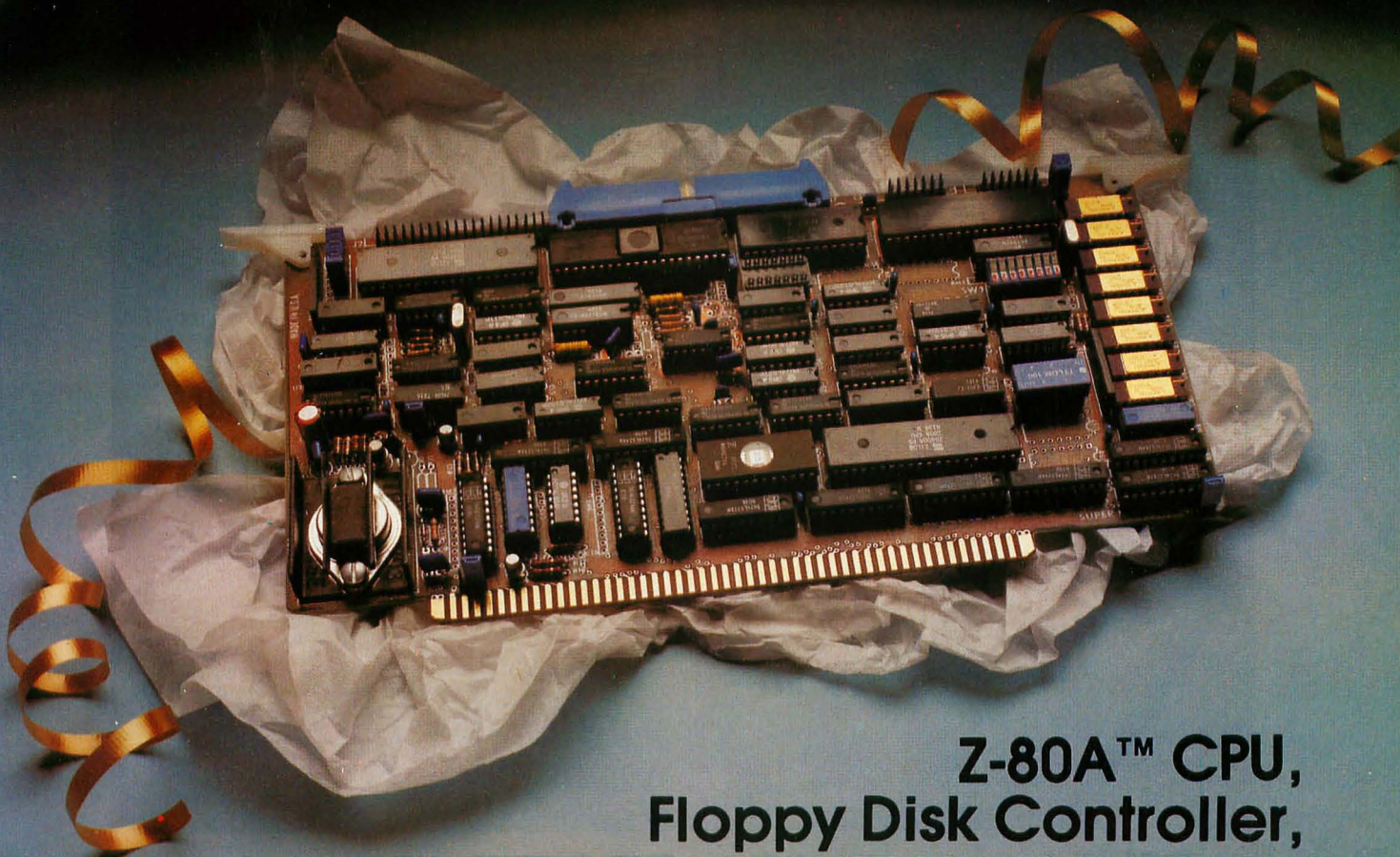
220 PRINT : PRINT "USE CONTROL-H TO BACKSPACE"
230 FOR J=1 TO Q2
240 PRINT "-----LINE ";J;"-----"
250 X=1
260 X$(J,X)=INPUT$(1)
270 IF ASC(X$(J,X))=8 THEN X=X-1 : PRINT CHR$(8) ; : GOTO 310
280 IF X$(J,X)=CHR$(13) THEN 320
290 PRINT X$(J,X);
300 X=X+1
310 GOTO 260
320 PRINT
330 D(J)=X-1
340 NEXT J
350 PRINT :PRINT
360 INPUT "IS THIS THE STRING YOU WANTED ";Y$
370 IF Y$="YES" THEN 390 ELSE 170
390 INPUT " WHAT MAGNIFICATION POWER ";MAG
400 PRINT
410 INPUT "WHAT ROTATION ANGLE (0-360) ";T1
420 T2=T1/57.2958
430 PRINT
440 INPUT "WHAT IS THE STARTING POINT ON THE PAGE ";A,B
450 A1=A : B1=B
490 REM
495 REM
500 REM THE COORDINATE PAIRS ARE STORED IN A RANDOM ACCESS FILE
505 REM THE RECORD NUMBER IS DETERMINED BY THE ASCII VALUE OF
510 REM THE LETTER TO BE WRITTEN. NOTE: THE CHARACTERS ARE
515 REM NOT STORED IN SEQUENTIAL ASCII FORMAT.
516 REM
517 REM
520 FOR J=1 TO Q2
530 FOR Q=1 TO D(J)
540 IF ASC(X$(J,Q))>96 THEN 600
550 IF ASC(X$(J,Q))>64 THEN 610
560 IF X$(J,Q)=" " THEN C=27*REC-REC+1:GOTO 620
570 IF X$(J,Q)="=" THEN C=28*REC-REC+1:GOTO 620
580 IF X$(J,Q)="?" THEN C=29*REC-REC+1:GOTO 620
590 C=(ASC(X$(J,Q))-10)*REC-REC+1 : GOTO 620
600 C=(ASC(X$(J,Q))-47)*REC-REC+1 : GOTO 620
610 C=(ASC(X$(J,Q))-64)*REC-REC+1
620 PRINT "THE RECORD # IS ";C
630 REM
635 REM
640 REM HERE WE GET THE COORDINATE PAIRS.
645 REM SOME OF THE CHARACTER SETS TAKE UP MORE
650 REM THAN ONE RECORD/CHARACTER.
660 REM
665 REM
670 FIELD #1,1 AS M$,2 AS L$,2 AS R$,2 AS H$
680 Z=0
690 FOR G=1 TO 59 STEP 2
700 FIELD #1,Z*4+7 AS D$,2 AS A$(G),2 AS A$(G+1)
710 Z=Z+1
720 NEXT G
730 GET #1,C
740 L=CVI(L$)
750 R=CVI(R$)
760 H=CVI(H$)
770 I=1
780 A(I)=CVI(A$(I))
790 A(I+1)=CVI(A$(I+1))
800 IF A(I+1)=-64 THEN 1100
810 IF I=59 THEN 850 ELSE I=I+2 : GOTO 780
840 GOTO 1100
850 H1=60
860 FOR Y=1 TO REC-1
870 I=0
880 FOR X=H1+1 TO H1+59 STEP 2
890 FIELD #1,I*4 AS D$,2 AS A$(X),2 AS A$(X+1)
900 I=I+1
910 NEXT X
920 C=C+1
930 GET #1,C
940 FOR X=H1+1 TO H1+59 STEP 2
950 A(X)=CVI(A$(X))
960 A(X+1)=CVI(A$(X+1))
970 IF A(X+1)=-64 THEN 1100
980 NEXT X
990 H1=H1+60
1000 NEXT Y
1050 REM
1055 REM
1060 REM THIS IS THE PART OF THE PROGRAM THAT OUTPUTS
1065 REM THE LETTER TO THE DECWRITER. THE DECWRITER
1070 REM ACCEPTS THE STRING REPRESENTATION OF EACH CHARACTER.
1075 REM A (-64,0) IS A LIFT PEN INSTRUCTION.

```

Listing 1 continued on page 195



# A Good-Buy Present.



## Z-80A™ CPU, Floppy Disk Controller, 64K of Memory, Serial & Parallel I/O Ports . . . all on a SINGLE S-100 BOARD!

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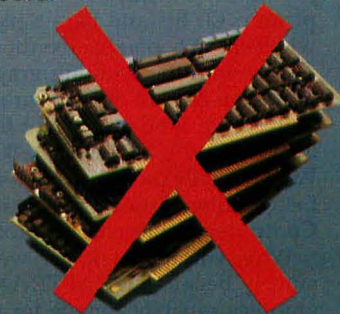
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Fill this space with a GRAFTRAX graphic  
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## The Epson "Softwear" Sweepstakes.

We're looking for the Picasso of programming. So we drew up an art contest for people who don't know a painting pallet from a PROM.

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All you have to do is program a GRAFTRAX graphic — abstract, landscape, still life, whatever — using an Epson MX-70, MX-80, MX-80 F/T or MX-100 printer. We'll not only put it on our T-shirts, we'll be displaying the winning entries for all to see in June at the National Computer Conference in Houston.

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All entries will be judged on originality, creativity and best use of computer equipment. They must be postmarked no later than May 1, 1982, and be accompanied by the software program, so we can recreate the winning entries for verification. Make sure the graphic is no larger than 8" x 10" and no smaller than 4" x 6". And remember, if you digitize art or a photograph, it must have been originally created by you.

So get busy and enter. You might be a winner.

And your software could be your "softwear."



**EPSON**  
EPSON AMERICA, INC.





## EPSON "SOFTWARE" SWEEPSTAKES RULES

- 1) Any computer equipment may be used to format the entry, but the graphics output must have been printed on an Epson MX-70, MX-80, MX-80 F/T or MX-100 printer with either built-in or optional GRAFTRAX. Winning entries will be re-created by Epson for verification.
- 2) Each entry must be accompanied by the software program used to create it. All entries and software and the rights to use them become the property of Epson America, Inc.
- 3) All entries must be at least 6"x4" and no larger than 8"x10" in size.
- 4) Art or photographs, if used, must have been created by the entrant.
- 5) All entries will be judged by an independent panel of judges on their creative merit, originality and best use of computer equipment. Decision of the judges is final.
- 6) This contest is valid from January 1, 1982 until May 1, 1982. Entries must be postmarked no later than May 1, 1982.
- 7) Participation in the Epson "Software" Sweepstakes is open to any except the following: employees of Epson America, Inc., its service agencies, or their families.
- 8) Winners will be notified by mail no later than June 1, 1982. A list of winners will be made available by sending a stamped, self-addressed envelope to Epson America, Inc., 3415 Kashiwa Street, Torrance, CA 90505.
- 9) Entries will be maintained on file at Epson America, Inc. until January 1, 1983.
- 10) Prizes are as follows: First prize includes round-trip economy air transportation for two to Tokyo, from the airport nearest the winner's place of residence, and six nights standard hotel accommodations, double occupancy. Trip does not include airport departure taxes, hotel service charges, cost of transportation or other expenses incurred before leaving the airport of initial departure, returning to Tokyo airport and returning home from the airport of initial departure; nor does it include meals or gratuities. Second prize consists of one Epson MX-100 Printer. Third prize consists of his and hers Seiko Quartz Watches. Additional prizes include 25 Micro-Nine Printheads, 50 Epson Digital Watches, and 100 Epson Ribbon Cartridges.
- 11) You may enter more than once, but each entry must be accompanied by the official entry coupon below.
- 12) Void where prohibited by law.

-----  
Attach this form firmly to the back of each graphic you enter.

NAME \_\_\_\_\_  
STREET \_\_\_\_\_  
CITY \_\_\_\_\_  
STATE \_\_\_\_\_ ZIP \_\_\_\_\_  
PHONE (\_\_\_\_) \_\_\_\_\_  
COMPUTER EQUIPMENT USED \_\_\_\_\_

PRINTER MODEL AND SERIAL NUMBER \_\_\_\_\_

T-SHIRT SIZE \_\_\_\_\_S \_\_\_\_\_M \_\_\_\_\_L \_\_\_\_\_X!

Mail entries to:

"SOFTWARE" SWEEPSTAKES  
Epson America, Inc.  
3415 Kashiwa Street  
Torrance, California 90505

**EPSON**  
EPSON AMERICA, INC.

Listing 1 continued:

```

1080 REM A (-64,-64) IS AN END OF CHARACTER INSTRUCTION.
1090 REM
1095 REM
1100 A=A-L*MAG*CDOS(T2)
1110 B=B-L*MAG*-SIN(T2)
1120 GOSUB 2000
1130 IF H=1 THEN 1300
1140 LPRINT "(";STR$(INT(A(1)*MAG+A));";";STR$(INT(A(2)*MAG+B));";. (J"
1150 FOR G=1 TO H*2-1 STEP 2
1160 IF A(G+1)=-64 THEN 1300
1170 IF A(G)=-64 THEN 1270
1180 A(G)=A(G)*MAG
1190 A(G+1)=A(G+1)*MAG
1200 A(G)=A(G)+A
1210 A(G+1)=A(G+1)+B
1220 LPRINT "(";STR$(INT(A(G)));";";STR$(INT(A(G+1)));";. ";
1230 IF V=1 THEN 1250
1240 LPRINT ")";
1250 V=0
1260 GOTO 1290
1270 LPRINT
1280 V=1
1290 NEXT G
1300 A=A+R*MAG*CDOS(T2)
1310 B=B+R*MAG*-SIN(T2)
1320 NEXT R
1360 REM
1365 REM
1370 REM NOW WE GO BACK TO THE START OF THE NEXT LINE
1380 REM
1390 REM
1400 IF REC>1 THEN 1440
1410 A1=A1+15*MAG*SIN(T2)
1420 B1=B1+15*MAG*CDOS(T2)
1430 GOTO 1465
1440 A1=A1+30*MAG*SIN(T2)
1450 B1=B1+30*MAG*CDOS(T2)
1465 A=A1 : B=B1
1470 NEXT J
1472 REM
1475 REM
1480 REM CHECK FOR ANYTHING ELSE TO PRINT OUT
1490 REM
1495 REM
1500 INPUT "DO YOU HAVE MORE TEXT ";Y$
1510 IF Y$="NO" THEN 1550
1520 PRINT
1530 INPUT "DO YOU WANT TO CHANGE CHARACTER SETS ";Y$
1540 IF Y$="YES" THEN CLOSE : GOTO 70
1542 REM
1543 REM
1545 GOTO 190
1547 REM
1548 REM
1550 LPRINT CHR$(27);"C"
1560 END
2000 REM
2010 REM
2020 REM THIS IS THE ROTATIONAL ALGORITHM USED TO ROTATE THE
2030 REM CHARACTERS ANY ANGLE FROM 0-360 DEGREES.
2033 REM THE COORDINATE PAIRS ARE STORED IN A 3*3 MATRIX, AND
2035 REM MULTIPLIED BY THE ROTATION MATRIX (ROTATION ABOUT
2038 REM THE POINT 0,0).
2040 REM
2045 REM
2050 IF T1=0 THEN RETURN
2060 FOR I=1 TO H
2070 S(1,I)=A(I*2-1)
2080 S(2,I)=A(I*2)
2090 S(3,I)=1
2100 NEXT I
2110 T(1,1)=COS(T2)
2120 T(2,2)=COS(T2)
2130 T(1,2)=SIN(T2)
2140 T(2,1)=-SIN(T2)
2150 T(3,1)=0
2160 T(3,2)=0
2170 T(3,3)=1
2180 FOR Y5=1 TO H
2190 IF A(Y5*2-1)=-64 THEN 2250
2200 FOR X5=1 TO 3
2210 Q(X5,Y5)=S(1,Y5)*T(X5,1)+S(2,Y5)*T(X5,2)+S(3,Y5)*T(X5,3)
2220 NEXT X5
2230 A(Y5*2-1)=INT(Q(1,Y5)+.5)
2240 A(Y5*2)=INT(Q(2,Y5)+.5)
2250 NEXT Y5
2260 RETURN

```



Text continued from page 186:

of Hershey-character alphabets. Starting from the top of the figure, these are: simplex Roman, simplex script, complex italic, triplex Roman, and Gothic English. At our laboratory, we now have the coordinates of these various character-printer sets stored on disk and can send them to the DECwriter under program control in any size desired. The coordinates for the simplex Roman characters occupy approximately 7K bytes of disk storage space, while the Gothic English files require more than four times that amount.

In addition to being able to vary the size of the displayed Hershey character sets, we also included in our program the ability to rotate characters to any angle. The effects of this routine, adapted from *Mathematical Elements for Computer Graphics*, by D. F. Rogers and J. A. Adams (see references), are shown in figure 4b, which displays several examples of character rotation; also shown is the

rotational algorithm that does the calculations necessary for the individual rotations. The BASIC program that outputs the Hershey coordinates as letters, starting at any location on the page, with any magnification and any degree of rotation, is given in listing 1.

Figure 5a is a three-dimensional plot of an exponential function showing the use of the graphics mode to display the lettering as well as the mathematical function itself. Figure 5b is a three-dimensional plot of the same function with certain lines hidden, with cross hatching, and labeled with graphically generated Hershey characters. Finally, shown in figure 5c is the three-dimensional representation of the quantum-mechanical wave function for a two-dimensional particle in a box.

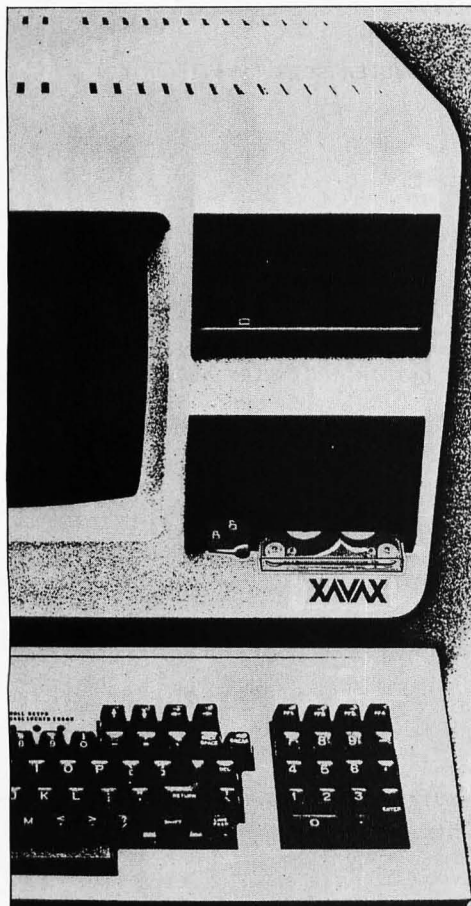
### Conclusion

The Selanar unit has been in operation in our laboratory for over a year and has performed flawlessly during

that time. The illustrations of the various graphs shown, especially the three-dimensional plots, with or without hidden lines, coupled with the development of programs to encode and output the different Hershey character sets, has made our DECwriter a truly versatile and low-cost generator of high-quality, high-resolution hard copy. ■

### References

1. *GRAPHICS II Installation and User Manual*. Selanar Corporation, Santa Clara, CA 1979.
2. Rogers, D.F. and J.A. Adams. *Mathematical Elements for Computer Graphics*. New York: McGraw-Hill, 1976, page 202.
3. Wolcott, N.M. and J. Hilsenrath. *A Contribution to Computer Typesetting Techniques: Tables of Coordinates from Hershey's Repertory of Occidental Type Fonts and Graphic Symbols*. Washington, D.C.: National Bureau of Standards Special Publication No. 424, U.S. Department of Commerce, U.S. Government Printing Office, 1976. Out of print.



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XAVAXTwo includes:

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# DATAROYAL INCORPORATED



# Custom and Standardized Forms for the Microcomputer User

---

Philip Lemmons  
c/o BYTE Publications Inc.  
POB 372  
Hancock, NH 03449

---

To help you find forms for your software, we are offering this brief account of the current marketplace of forms for microcomputer users.

Some microcomputer users have written their own software; others have bought one or more commercial programs. Many microcomputer users run both software of their own and commercial programs.

A number of companies stand ready to help you with various *stock*, *custom*, or *standardized* forms. Table 1 (page 200) lists companies active in this market. Table 2 (page 202) summarizes the product offerings of these companies and the minimum orders required for custom and standardized forms. I have also included brief information about these companies' offerings, if any, of continuous custom letterheads.

While stock forms are of several common types, they are not written

specifically for one company's computer or software. Nevertheless, stock forms *do*, in fact, work with many commercial programs. Companies offering stock forms are too numerous to list. If stock forms will work with your commercial programs, or if you can write software that uses stock forms, you will be able to get the forms you need at an economical price. Some companies make the use of stock forms easier by providing programmer's guides for use of the form, e.g., a grid with rows and columns numbered and data fields highlighted.

But the focus of this article is on *custom* and *standardized* forms. Custom forms, of course, are designed to go with unique, user-written software. What I am calling *standardized* forms are designed to go with specific pieces of commercial software. If you buy an accounting

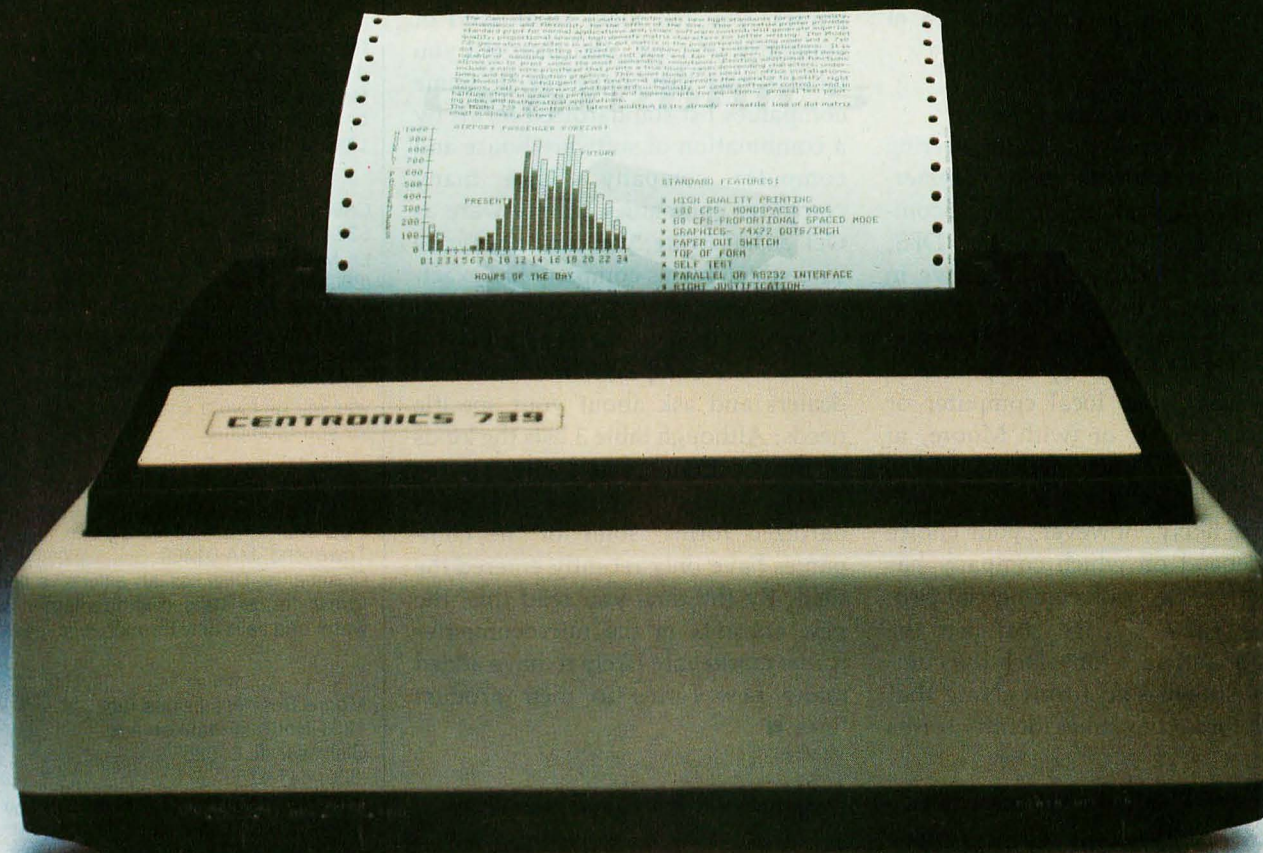
program from the fictitious Ersatz Software, for example, and you know someone who sells forms for the Ersatz programs, you won't need to spend any time adapting the software to your forms or spend any legwork looking for stock forms that happen to be compatible with the software.

## Custom Forms

If you absolutely must do things your own way down to the last detail, custom-designed and printed forms are for you. Many companies produce custom forms. These companies are found under "Business Forms" in the Yellow Pages. Minimum order quantities vary greatly. The companies listed in table 2 that do custom forms accept orders for minimums ranging from 1000 to 5000. Pricing varies with the com-



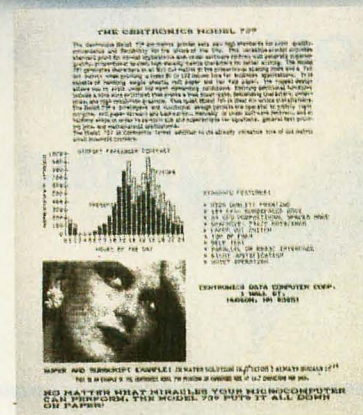
# THE CENTRONICS 739. IT'S A LOT MORE THAN YOU'D EXPECT TO SELL FOR THE PRICE.



Inexpensive doesn't have to mean incomplete, and the quiet, dependable Centronics 739 is the classic example. It's complete in capability and because it's from Centronics you can expect it to perform just like the workhorse printers that have made Centronics a leader in the business for more than a dozen years. So when you shop for a desk-top printer and compare features, here's what you can expect from a 739:

**CORRESPONDENCE QUALITY**—Clear, high density characters plus right justification and proportional spacing that produce correspondence, direct mail, and other important documents that demand a "custom" quality appearance.

**BUSINESS GRAPHICS**—What good is a printer that can't print your technical business/management information? The 739 produces a range of graphics—from bar charts and curves to illustrative material—almost anything your computer can produce.



**3-WAY PAPER HANDLING**—Cut sheets for correspondence; roll paper for day-to-day operations; fan-folded forms for normal data printout.

**DEPENDABILITY**—You depend on your printer for hard copy of timely information and that means it must operate dependably. With Centronics reputation behind the 739, reliability is a foregone conclusion. More than 350,000 Centronics printers sold worldwide is the proof.

**SERVICE**—Someday you may need it. Where do you find it? With Centronics worldwide network of service locations it's not very far. And now, there are authorized Centronics sales and service dealers, and "walk-in" service centers in an expanding number of key cities throughout the U.S.

When it comes to printers, Centronics is the leading independent printer manufacturer—chosen by computer professionals in major industry brand preference studies. So when you look for an inexpensive printer don't settle for incomplete. Choose the Centronics 739. It comes complete with a commitment—to performance, dependability and service. See it at your Centronics dealer. Or write for information.

## CENTRONICS® PRINTERS

Circle 70 on inquiry card.



plexity of the form. Many companies stress that it makes little sense to buy only 1000 custom forms because 5000 cost relatively little more—much of the cost lies in the unique design of the form.

### Standardized Forms

A few companies are now offering forms to go with standard, commercial software packages for microcomputers. NEBS, Checks-to-Go, DFS, Moore, and Trinity are all active in this market. Your choice of a company might depend on whether you want to buy forms by telephone or mail, from your local computer or software dealer, or (with Moore, at least) from the company's own local office.

More likely, however, your choice will depend on which company has the forms for your commercial programs. Table 3 (page 204) lists the kinds of software for which the companies shown sold forms. Note that not all these companies identify forms

the same way. Some companies list their standardized forms primarily by reference to software houses. Others refer primarily to computer companies: you tell them what kind of computer you use, and they tell you what forms they have for it. Some companies list standardized forms by a combination of software house and computer company. Since many computer companies sell software as well as hardware, you can't always be sure which forms company has exactly what you need.

Perhaps the wisest course is to contact all the companies or their local dealers and ask about your specific needs. Although table 3 lists the kinds of microcomputers and software for which various companies offer standardized forms, some of the companies have only recently entered the field. By the time you read this, the new entrants in the microcomputer forms market are likely to have added many new forms to their product lines. ■

Check-Mate  
POB 103  
Randolph, MA 02368  
(617) 963-7694

Comments: Check-Mate sells only by direct mail and telephone. Its custom forms are limited to checks; its standard computer forms are for Radio Shack and Libra software only.

Checks-to-Go  
8384 Hercules St.  
La Mesa, CA 92041  
(800) 854-2750  
(800) 552-8817 (California residents only)  
Comments: Checks-to-Go sells only by direct mail and telephone. Tell Checks-to-Go what kind of computer you have and you will receive a sample kit of its forms for your computer.

DFS Computer Forms  
POB 643  
Townsend, MA 01469  
Comments: DFS has an extensive line of forms for existing microcomputer software and sells only through local dealers.

Moore Business Forms inc.  
1205 North Milwaukee Ave.  
Glenview, IL 60025  
(800) 447-4700  
(800) 322-4400 (Illinois residents only)  
Comments: Moore sells forms through more than 600 of its own local sales offices around the United States. Check the Yellow Pages or call Moore's toll-free numbers to find out the name of your local dealer.

NEBS Computer Forms  
78 Hollis St.  
Groton, MA 01471  
(800) 225-9550  
(800) 922-8560 (Massachusetts residents only)  
Comments: NEBS sells only by direct mail and telephone. On request, NEBS sends a helpful, cross-indexed Forms Selector Guide and a catalog with programmer's guides for each form.

Trinity Forms Company  
Micro Computer Forms Program  
Carrollton, TX 75006  
(800) 527-0625  
(800) 492-5232 (Texas residents only)  
Comments: Trinity sells through local dealers only. Contact Trinity on a toll-free number for the name of your local dealer. Trinity plans to introduce a large line of standard forms for many different microcomputer software packages.

**Table 1: Some companies selling standardized or custom forms for microcomputers.**

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- Quality design
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- Personalized assistance
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That's why the ATARI computer has equipped its 6502 with its own electronic assistant. It's called ANTIC, and it handles all the display work, leaving the 6502 free to handle the rest. What this means to you is uncompromisingly spectacular display capabilities without loss of computer power needed to carry out the demands of your program.

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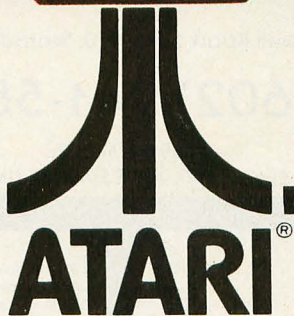
**Language.** The ATARI Personal Computer uses several programming languages to give the user maximum control of its extraordinary capabilities. PILOT, Microsoft BASIC\*, and ATARI BASIC are understood and spoken by the ATARI computer. You'll also find our Assembler Editor cartridge indispensable for machine language programming.



**Sound.** An ATARI computer has four sound generators, or voices, activated by a separate microchip. This leaves the principal microprocessor chips free to perform other tasks. And you can take full advantage of this capability which is designed for easy programming.

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\*ATARI 800™ computer only.



	Check-Mate	Checks-to-Go	DFS	Moore	NEBS	Trinity
How Sold	Mail and telephone	Mail and telephone	Local dealers	Local offices	Mail and telephone	Local dealers
CUSTOM FORMS	Checks only	Y		Y	N	Y
Minimum quantity	5000	5000		1000-2500		1000
CUSTOM CONTINUOUS LETTERHEAD	Y	Y		Y	Y	Y
Minimum quantity	1000	5000		1000-2500	500	1000
STANDARDIZED FORMS	Y	Y	Y	Y	Y	Y
Minimum quantity	1000	500		1000	500	500

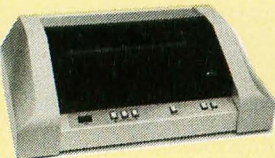
**Table 2:** Information about how six companies sell custom and standardized forms for microcomputers. Important considerations include minimum order quantities and sales methods—whether through a company's own local offices, through local dealers, or by mail and telephone.

### IMPORTS



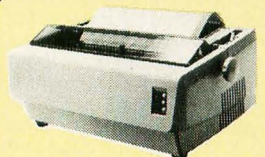
NEC 8023A ..... \$495  
Epson MX-80's, 100's, etc. .... Call  
Okidata 82A ..... \$469  
Okidata 83A ..... \$749  
Okidata 84 ..... \$1059

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Anadex 9500, 9501 ..... \$1245  
Datsouth DS-180 ..... \$1269  
TI 810 Basic ..... \$1365  
Infoscribe ..... Call

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C.Itoh Starwriter-IP ..... \$1324  
C.Itoh Starwriter II S ..... \$1595  
NEC 3500 ..... \$1995  
NEC 7710/7730 ..... \$2340  
Diablo 630 ..... \$2295

## COMPUTERS



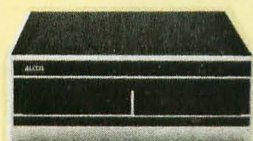
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Televideo 910 ..... \$589  
ADM 3A ..... \$569  
Soroc IQ 130 ..... \$589

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Televideo 920 ..... \$728  
Televideo 925 ..... \$775  
Televideo 950 ..... \$927

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Check-Mate	Checks-to-Go	Moore	NEBS	Trinity	DFS
		Accounting Plus Allison Crain	Agency Computer Systems		Agency Computer Systems
	Alpha Micro Anchor Systems				
	Apple Computer	Apple Computer	Antech Apple Computer Applied Business Software Atlanta Business Computer Balcones Computer Corp. Biss		Antech Apple Computer Applied Business Software Atlanta Business Computer Balcones Computer Corp. Biss
	BPI Systems Briareus	BPI Systems		BPI Systems	
			Broderbund Software Business Enhancement Compuservice		Broderbund Software Business Enhancement Compuservice
	Cado	Cado Canon U.S.A.			
	Centurion-Warrex-Eds Cimarron		Cape Cod Computer		Cape Cod Computer
			CMS Software Systems Coelco Software Systems COM Business Computer Systems Compumax Associates		CMS Software Systems Coelco Software Systems COM Business Computer Systems Compumax Associates
	Computax		Computerease Inc. Computer Products International Computer Research Computerware Inc. Computhink Continental Software		Computerease Inc. Computer Products International Computer Research Computerware Inc. Computhink Continental Software
	Continental Software	Cromemco			
			CTI Custom Accounting Customation Custom Computing D.B. Software Dakin-5		CTI Custom Accounting Customation Custom Computing D.B. Software Dakin-5
		Data General			
		Data Train	Data Solutions Data Train Data Universal Datavision Davis-Lane		Data Solutions Data Train Data Universal Datavision Davis-Lane
		DEC			
			Delphic Systems Delta Software Denver Software Company		Delphic Systems Delta Software Denver Software Company
	Designer Software DIBS Digilog Digital Systems				
	Durango Dynabyte	Durango	Digital Tech Duchess Enterprises Durango		Digital Tech Duchess Enterprises Durango
			Ecosoft EDP Business Systems Electronic Information Systems Fox Computer Systems Functional Solutions Glenn/Cliff Associates Haland Data Systems H & E Computronics		Ecosoft EDP Business Systems Electronic Information Systems Fox Computer Systems Functional Solutions Glenn/Cliff Associates Haland Data Systems H & E Computronics
	IBM 5120 IBM Systems 32/34	Hewlett-Packard			

**Table 3:** Hardware and software sources for which these companies produce standardized forms. Keep in mind that a company that produces forms for one program from a particular software house may not produce forms for all programs from that house. Furthermore, a company that produces forms for one computer from a certain manufacturer may not produce forms for every computer from that manufacturer. In addition, since some of these forms companies entered this market shortly before the research was done for this article, they may by now offer forms for more computers and more software.



Check-Mate	Checks-to-Go	Moore	NEBS	Trinity	DFS
	IMS		ICM Computer Systems Idea Micro Design		ICM Computer Systems Idea Micro Design
	Insoft		Info Designs		Info Designs
			Interactive Operations Associates		Interactive Operations Associates
			International Computer Service		International Computer Service
			International Data Tech		International Data Tech
			Key Systems		Key Systems
			Legler Systems		Legler Systems
			Lenz, Masterson & Associates		Lenz, Masterson & Associates
Libra	Libra	Libra	Mark/Donn Associates George Matyjewica & Company		Mark/Donn Associates George Matyjewica & Company
	MCBA MCS		Medfield Computer Software		Medfield Computer Software
			Microcomputer Consultants		Microcomputer Consultants
			Micro-Management		Micro-Management
			Midwest Data Services		Midwest Data Services
			Mitex		Mitex
			Montour Computer Systems		Montour Computer Systems
		Moore	Murray Jones Murray Engineers		Murray Jones Murray Engineers
	NEC	NEC			
	North Star				
	Osborne				
	Peachtree	Peachtree		Peachtree	
			P.G. & J. P K Systems		P.G. & J. P K Systems
Radio Shack	R & B Systems Radio Shack	Radio Shack	Radio Shack Realistic Computing of Georgia G.A. Rock Systems Group Rocky Mountain Software RTG Data Systems S & M Systems Score		Realistic Computing of Georgia G.A. Rock Systems Group Rocky Mountain Software RTG Data Systems S & M Systems Score
		Serendipity Software			
	Shasta		Small Business Systems Group Small Systems Software Software Services Software Technology for Computers		Small Business Systems Group Small Systems Software Software Services Software Technology for Computers
	Structured Systems	Structured Systems	Synergetic Computer Systems		Synergetic Computer Systems
	Systems Plus		Tailored Data Taranto & Associates Targhee Software Engineering TBSB	Systems Plus	Tailored Data Taranto & Associates Targhee Software Engineering TBSB
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## Base 2 Printer

Walter Jeffries  
RFD 1  
Readfield, ME 04355

Recently, after considering it for quite awhile, I added a printer to my system. My choice was the Base 2 printer, which I use with an Exidy Sorcerer with 32K bytes of RAM (random-access read/write memory). I bought the printer used for \$470, complete with most of its options (tractor feed, graphics option, and expanded character buffer). Parts of this article may not apply to Base 2 printers that lack these options.

### Construction

This compact printer measures 7.5 by 24.5 by 35.6 cm (3 by 11 by 15 inches) and is constructed of aluminum, which makes the printer surprisingly heavy for its size. The aluminum chassis acts as a heat sink for the large-scale integrated (LSI) circuits, making a fan unnecessary if the printer has an unimpeded airflow. Designed around the 8085 microprocessor and other LSI chips, the printer has few components but great flexibility. Behind the tractor mechanism is a removable panel that provides access to two erasable programmable read-only memories (EPROMs).

One EPROM contains the printer's program and the standard character set, consisting of 96 ASCII characters. The other EPROM can contain auxiliary character sets; it does not come standard with the printer. The paper inlet is located in the bottom of the printer, and the friction

feed mechanism is located inside. In the upper left-hand corner of the printer's back panel is the power switch. Also on the back panel are the three interface connectors, power inlet, mode switches, and the reset/self-test switch. On the front panel are the formfeed (FF) and unit-select switches.

### Interfaces

The Base 2 printer has three interface connectors that support four popular interfaces: RS-232, 20-milliampere (mA) current loop, Centronics parallel, and IEEE-488. You select the interface mode by using two switches of an eight-position miniature DIP (dual-inline package) switch located under the power switch. The next four switches set the default line length from any of five of the six line densities. The remaining two switches determine the "pinout" (lines assigned to the socket pins) for the serial interfaces. Also on the back panel is the data rate/unit-number switch, which consists of a 16-position thumb-wheel switch. In the serial mode this switch determines one of 15 data rates ranging from 75 to 9600 bits per second. In the IEEE-488 interface mode this switch acts as the unit-number switch. In the parallel mode this switch is not used.

An additional mode recommended for the TRS-80 uses the parallel interface and a line length of 80

### At a Glance

**Name**

Base 2 printer

**Use**

Medium-quality printer

**Manufacturer**

Base 2 Inc.  
POB 3548  
Fullerton, CA 92634  
(714) 533-0111

**Dimensions**

7.5 by 24.5 by 35.6 cm (3 by 11 by 15 inches)

**Price**

\$699

**Hardware Needed**

Host computer with one of four interfaces: RS-232, 20-mA current loop, Centronics parallel, IEEE-488

**Software Needed**

Appropriate driver for interface

**Hardware Options**

Tractor feed, paper holder, graphics option, expanded buffer

**Features**

Print speed: 100 cps bidirectional. Form-feed speed: 1.5 inches per second. Six character densities with elongated printing. Standard 96 ASCII characters in 5 by 7 dot-matrix font. Nine additional user-defined character fonts.

**Documentation**

74-page paperback

**Audience**

Computer hobbyist desiring a flexible, inexpensive printer



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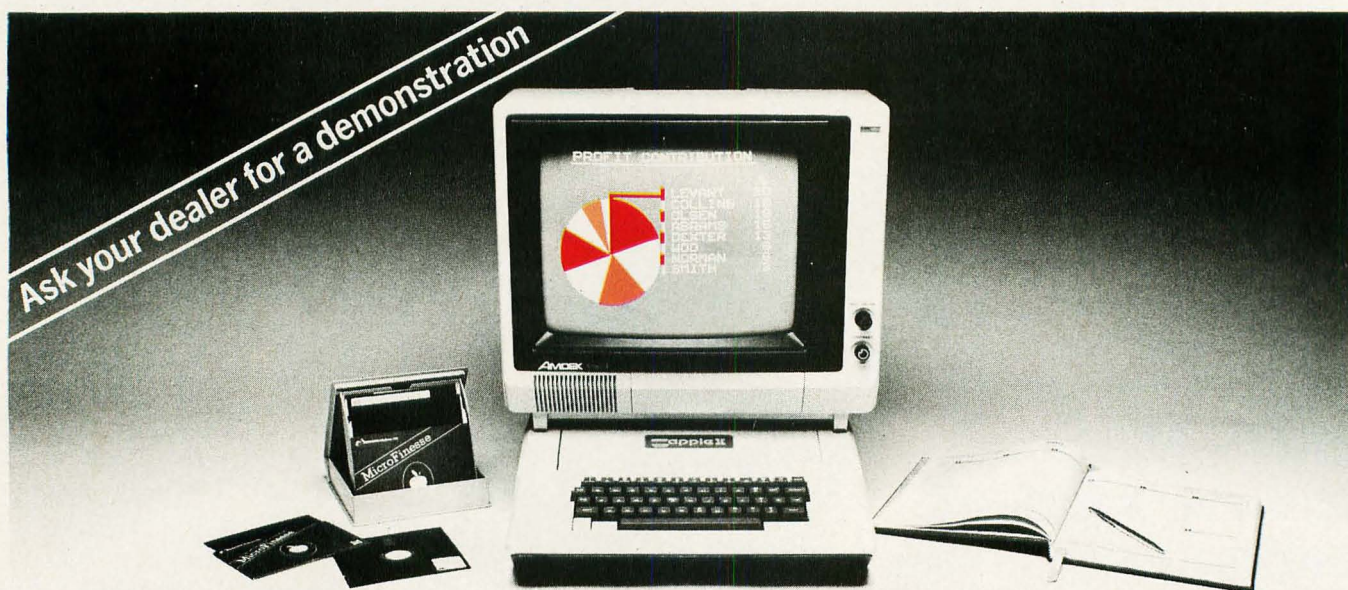
ASCII	Hexadecimal	Decimal	Code	Operation
CTL I	09	09	HT	Horizontal Tab
CTL J	0A	10	LF	Linefeed
CTL K	0B	11	VT	Vertical Tab
CTL L	0C	12	FF	Formfeed
CTL M	0D	13	CR	Carriage Return
CTL N	0E	14	SO	Elongated Characters
CTL Q	11	17	X-ON	Selects unit online
CTL S	13	19	X-OFF	Deselects unit offline

**Table 1:** The control codes of the Base 2 printer.

characters, with automatic linefeed (LF) on receipt of a carriage return (CR).

### Power Supply

My printer came wired for 110 volts of alternating current, but it can easily be rewired for 210 volts. Written directions and diagrams are in the operator's manual. Since the stepping motors are direct current (DC) and independent of the line frequency, the printer does not need to compensate for frequencies of 50 or 60 hertz (Hz).



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## Manual Control

The Base 2 printer's front panel consists of a unit-select switch and a formfeed switch. When the unit-select switch is on, the formfeed switch causes the printer to eject paper to the top of the next form (default form length is 66 lines per page). When the switch is off, the formfeed switch causes the paper to advance at a rate of 1.5 inches per second.

In the upper right-hand corner of the printer's back panel is the reset/self-test switch. When toggled to the left, this switch resets the printer to its default mode. When the reset/self-test switch is toggled to the right, the printer prints a line of characters using the present mode. The self-test switch allows testing the printer independently of the host computer.

## Software Control

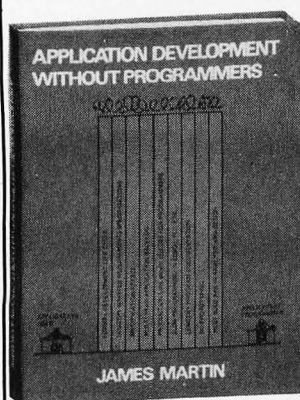
Two sets of software controls have functions that overlap to a slight degree. One set consists of "control codes" (table 1); the other set consists of "function codes" (table 2). To take effect, the function codes must be prefixed by an ESC (ASCII 27). Some of the function codes must be followed by data, as when setting tabs.

The Base 2 printer supports six character densities (64, 72, 80, 96, 120, and 132 characters per line), as well as elongated characters (10 dots wide rather than 5) in all character densities.

The standard character set contains 96 ASCII characters in a 5 by 7 dot-

ASCII	Hexadecimal	Decimal	Function
J	4A	74	General printer reset
H	48	72	Unit select
I	49	73	Unit deselect
j	6A	106	Enable unidirectional printing
k	6B	107	Enable bidirectional printing
R	52	82	Enable 1920 character buffer
S	53	83	Disable 1920 character buffer
5	35	53	Disable print on buffer full
6	36	54	Enable print on buffer full
7	37	55	Enable auto LF following CR
8	38	56	Disable auto LF following CR
B	42	66	Enable CR recognition
C	43	67	Disable CR recognition
D	44	68	Enable LF recognition
E	45	69	Disable LF recognition
V	56	86, n1...n16	Set horizontal tabs
X	58	88	Reset horizontal tabs
Y	59	89, n1...n10	Set vertical tabs
a	61	97	Reset vertical tabs
@	40	64	Enable elongated characters
A	41	65	Disable elongated characters
T	54	84, n	Set form length to n lines
9	39	57, n	Set auto FF count
:	3A	58	Enable auto FF
;	3B	59	Disable auto FF count
F	46	70, n	Set eject to n lines
G	47	71	Eject
d	64	100	Set line length to 64 chars.
0	30	48	Set line length to 72 chars.
1	31	49	Set line length to 80 chars.
2	32	50	Set line length to 96 chars.
3	33	51	Set line length to 120 chars.
4	34	52	Set line length to 132 chars.
b	62	98, n	Set vertical line density
c	63	99, data	Enable and send graphics
K	4B	75, data	Load user-defined characters
L	4C	76	Enable user-defined chars.
M	4D	77	Enable Standard ASCII chars.
O	4F	79	Enable optional chars. 1
P	50	80	Enable optional chars. 2
Q	51	81	Enable optional chars. 3
e	65	101	Enable optional chars. 4
f	66	102	Enable optional chars. 5
g	67	103	Enable optional chars. 6
h	68	104	Enable optional chars. 7
i	69	105	Enable optional chars. 8

**Table 2:** The function codes of the Base 2 printer. All function codes must be preceded by an ASCII <ESC> (escape, hexadecimal 1B, decimal 27) in order to take effect.



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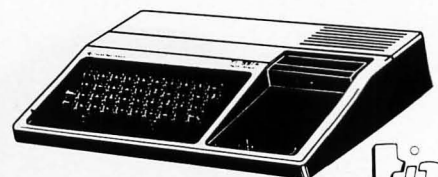


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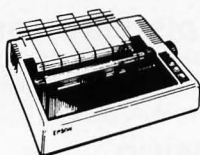
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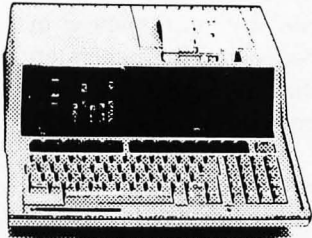
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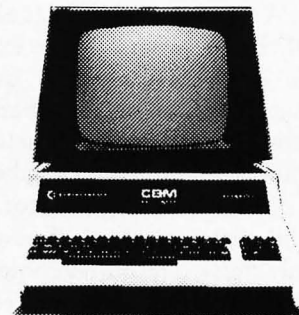
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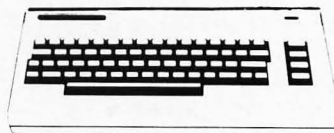
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The expanded buffer allows storage within the printer of a full screen (1920 characters). The buffer contents are printed either when the buffer is full or the print-buffer function code is received. The print on buffer full can be optionally disabled with a function code.

The graphics feature provides six horizontal densities up to 99 dots per inch and a constant vertical density of 72 dots per inch. Table 3 shows the character set in different densities. To use the graphics mode, you send the graphics-mode-enable function code

followed by a full line of graphics data. The graphics data consist of bytes in which the lower 7 bits control the seven wires in the print head. The printer automatically prints the line of graphics upon receiving a full line of data. Since the printer does not linefeed automatically in the graphics mode, you must send an LF after each line of data. Figure 1 shows a printout of my name in script, produced by using the graphics mode.

## Documentation

The documentation for the Base 2 printer is well done. It consists of a single 74-page *Operator's Reference Manual* that is divided into five sections plus appendixes. The sections cover installation, operation, internal specifications, and software control. Each control code and function code has a complete written description followed by a demonstration program in BASIC. The appendixes cover the hardware, providing full

schematic diagrams and component layouts for the logic boards, as well as the parts lists.

## Disaster and Recovery

After I wrote the first draft of this article, disaster struck at a most inconvenient time (couldn't Murphy have waited?). I had used my computer to write my term papers in school and had saved the papers on tape. When the time came to print the papers and pass them in, the printer blew a fuse. Okay, I thought, no problem. Just a fuse. Having noticed that the lights had flickered earlier, I thought it was probably just a power surge. I made sure that none of the mechanical parts had stuck, and then I inserted a new fuse. That blew immediately. My printer was not under warranty. Besides, I needed the printer *now*; I could not afford to wait six weeks for the company to fix it. Well, everything was not against me. With the help of the *Operator's*

```
64 characters per line:
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Elongated:
! "##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ

72 characters per line:
"##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
Elongated:
! "##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ

80 characters per line:
"##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
Elongated:
! "##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ

96 characters per line:
"##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
Elongated:
! "##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ

120 characters per line:
"##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
Elongated:
! "##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ

132 characters per line:
"##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
Elongated:
! "##1.8" (C)*+, -./0123456789:;<=>?@ABCDEFGHIJKLMNPOQRSTUVWXYZ
```

Table 3: Printouts of the Base 2 printer character set. The densities range from 64 characters per line to 132 characters per line.



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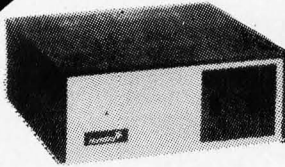
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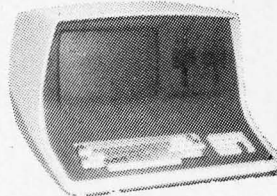
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Figure 1: A printout produced using the Base 2 printer's graphics mode. The printer renders the author's name in script.

Reference Manual and a multimeter, I was able to determine that the diodes in one of the bridge rectifiers of the power supply had blown, creating a short circuit. The parts were standard; the night before my papers were due, I got the parts and fixed the printer.

This experience put quite a strain on my nerves, but it did teach me that the printer is quite simple to dismantle and repair.

## **Conclusions**

The following conclusions can be made about the Base 2 printer. It is rugged and is backed up with a good manual listing all the parts and containing schematics and layouts.

The printer's format is very flexible and can be changed under software control or, to a lesser degree, by hand. It requires a driving program in the host computer to do the handshaking.

The printer can support as many as 10 character fonts: standard 96-character ASCII, user-defined, and eight more fonts, all in EPROM.

It accommodates four major interfaces: RS-232, 20-mA current loop, Centronics parallel, and IEEE-488. The printer provides high-resolution graphics.

The print rate is 100 characters per second, with bidirectional printing. Both hardware and software are well documented with many diagrams and examples. ■

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# The Fill Forms System

## CP/M Programs to Cut Down on Paperwork

---

Bill Roch  
24000 Bessemer St.  
Woodland Hills, CA 91367

---

We live in a paper-mill world with a form for just about everything. And someone has to fill out all those forms. A computer can make form handling easier because it can be programmed to do the complete job, but if there are many forms then you'll need many programs to fill out these forms—right? Wrong. You can do it with three programs.

The Fill Forms System is composed of three CP/M-based programs. The first, FFGRID-1, is used to determine the line and column position for each data field. The next, FFTABL-1, is used to build a control table that is used by the third program, FFORM-1, for data entry and forms

printing. These programs are relatively simple and, best of all, easy to use.

---

**Form designers have been known to ignore the fact that typewriters and printers are generally unable to handle forms with unusual line spacing.**

---

Each of these programs is written in Microsoft BASIC and is designed for use on a CP/M-based system (CP/M versions 1.4 through 2.2).

### Determining Field Positions

The idea behind the system is to establish the line and column position for each data field to be printed on the form, then enter the data and print it in the proper position.

Field positions may be determined by measuring the number of lines in the form and finding the width by counting the spaces from the left side

of the form (see figure 1). Once line position 1 and column position 1 are established as reference points, all other field locations can easily be determined—if you count correctly.

This method works fine for a form with a few fields, but when there are a number of fields, it is better to draw a grid on the form and then determine the field positions from the intersections of the horizontal and vertical lines of the grid.

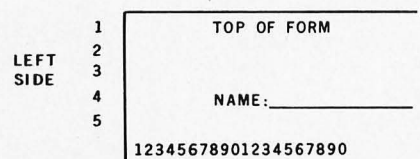
### Gridding the Form

The FFGRID-1 program is used to produce a grid on a form (see listing 1). The program prints a row of col-

---

**Editor's Note:** Copies of these programs, on either 8-inch single-density CP/M disks or 5¼-inch single-density disks for North Star CP/M users complete with instruction manual can be obtained for \$20 from Elliam Associates, 24000 Bessemer St., Woodland Hills, CA 91367. Programs with the enhancements mentioned in the article are also available.

---



**Figure 1:** Each field position is determined by its particular reference points. The form is divided into numbered rows and columns. In this example, the data for the NAME field should be placed on line position 4 and start in column position 14.



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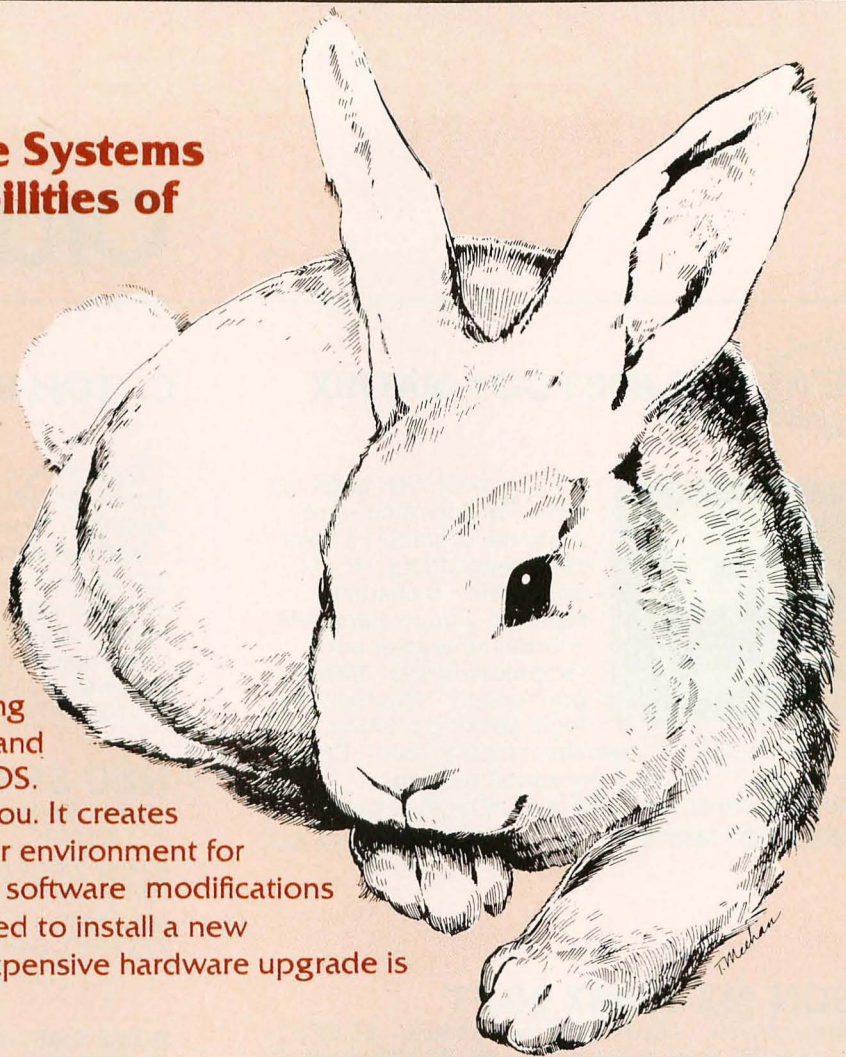
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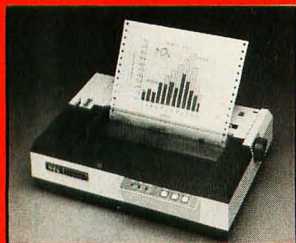


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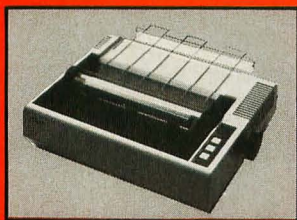
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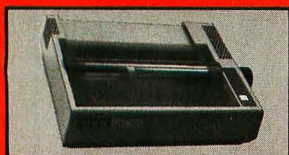
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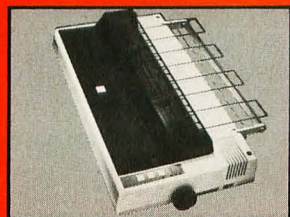
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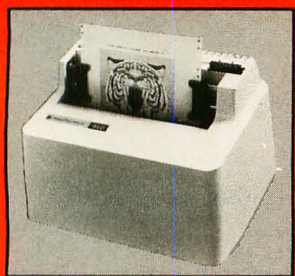
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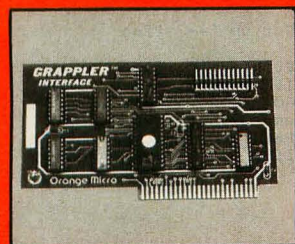
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umn positions across the top of the form and on every tenth line. It also prints each line position on both edges of the form as well as horizontal and vertical grid lines. Since plus and minus characters are used, the grid intersections are at the center of a character rather than to the left and under it.

The program requires that you enter only the form size: the number of lines per page and the width in columns. After you position the form, the program prints an asterisk (\*) in line position 1 and column position 1. You can then reposition the form if necessary. Any number of attempts at repositioning may be tried, since

*Text continued on page 228*

**Listing 1:** The FGRID-1 program prints a grid on your form. Each plus or minus character denotes the center of a character.

```

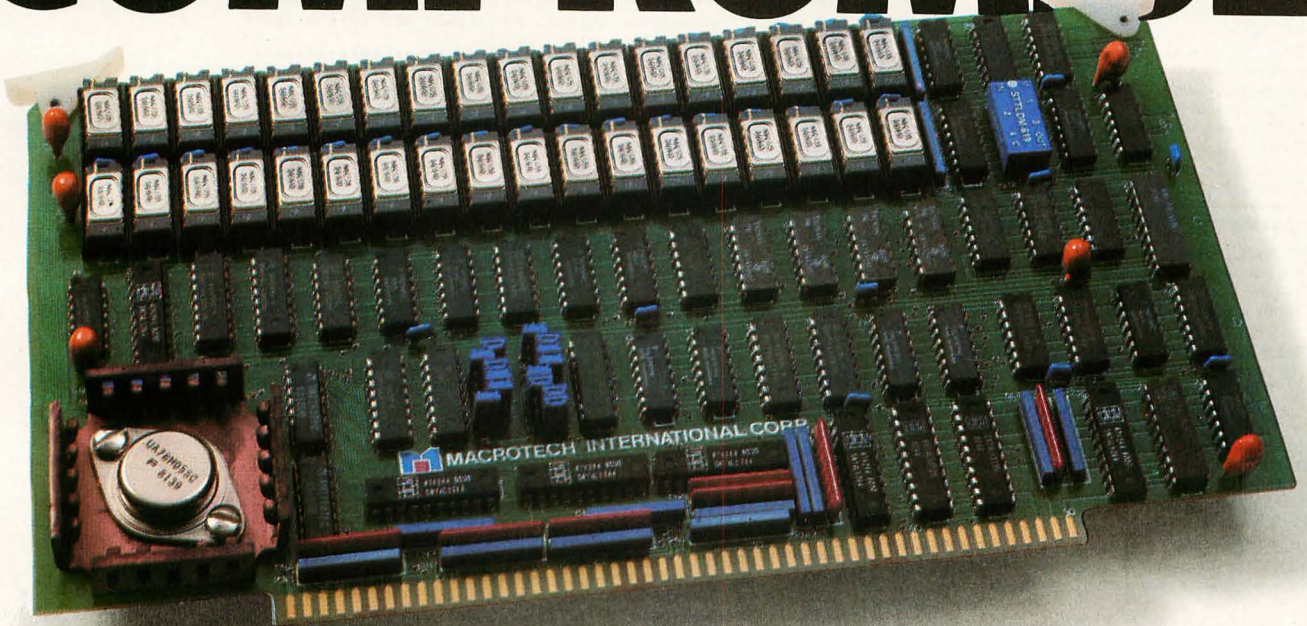
10 *****
20 ***
30 PRINT: PRINT
40 PRINT " FGRID-1.BAS"
50 PRINT " Form Grid Program"
60 PRINT "Copyright 1981 by Elliam Assoc."
70 ***
80 *** This program prints a grid on a
90 *** form.
100 ***
110 *****
120
500 PRINT: INPUT "Form length: ",L%
510 INPUT " Form Width: ",W%
520 PRINT: INPUT "Position Form c/r ",X$
530 LPRINT " ";
540 PRINT
550 INPUT "OK (Y or N): ",X$
560 IF X$="Y" GOTO 1020
570 LPRINT CHR$(13);
580 GOTO 520
590
1000 BUILD COLUMN NUMBER LINE
1010
1020 HORZ$="": FOR K%=1 TO W%
1030 A$=MID$(STR$(K%),2)
1040 HORZ$=HORZ$+RIGHT$(A$,1)
1050 NEXT
1060
1200 BUILD GRID LINE
1210
1220 DP$="": DASHPLUS$="---+"
1230 FOR K%=1 TO W%/5+1
1240 DP$=DP$+DASHPLUS$
1250 NEXT
1260 DP$=LEFT$(DP$,W%)
1270
1300 PRINT TOP COL NUM LINE
1310
1320 LPRINT MID$(HORZ$,2)
1330 J%=1
1400 PRINT GRID LINES
1410
1420 FOR K%=2 TO L%-1
1430 A$=MID$(STR$(K%),2)
1440 LPRINT A$;
1450 IF J%=0 GOTO 1500
1460 DPLUS$=MID$(DP$,LEN(A$)+1)
1470 DPLUS$=LEFT$(DPLUS$,LEN(DPLUS$)-LEN(A$))
1480 LPRINT DPLUS$;A$
1490 GOTO 1520
1500 GOSUB 3020
1510 LPRINT HZ$;A$
1520 J%=J%+1: IF J%=10 THEN J%=0
1530 NEXT
1540
2000 PRINT BOTTOM COL NUM LINE
2010
2020 A$=MID$(STR$(K%),2)
2030 GOSUB 3020
2040 LPRINT A$;HZ$;A$
2050 END
2060
3000 SETUP COL NUM LINE
3010
3020 HZ$=MID$(HORZ$,LEN(A$)+1)
3030 HZ$=LEFT$(HZ$,LEN(HZ$)-LEN(A$))
3040 RETURN
  
```

'Print alignment mark  
 'OK ?  
 'Its ok  
 'Print c/r only  
 'Try again  
 'Build a column  
 'number print line  
 'Build grid line  
 'Print line number  
 'Set up '+' line  
 'Print grid line &  
 'line number on rt.  
 'Go build col num line  
 'and print it  
 'Reset for every 10th  
 'line



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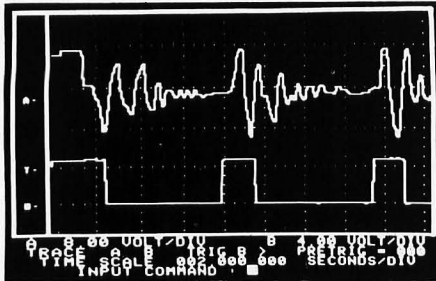
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**APPLESCOPE-HRHS** High Resolution AND High Speed. Circuit combines two 6 bit flash analog to digital converters to give a 10 bit dynamic range. The 10 bit converter resolution is maintained at sampling rates up to the 7 Mhz. maximum for signal slew rates less than .5 volts per microsecond. Larger inputs slew rates will reduce the converter resolution to 6 bits until the signal stabilizes within the .5 Volt per microsecond limit. Requires 48K Apple II with disk drive. Software provided on disk includes the basic SCOPE DRIVER package. Price per channel **\$695**

**APPLESCOPE-EXT** External trigger adapter has a switch selectable external trigger input to a BNC connector mounted in a rear slot of the Apple II computer. Price **\$29.00**

**APPLESCOPE-BNC** BNC adapter connects the Berg stick connectors on the A1 circuit card to male BNC plugs mounted in a rear slot of the Apple II computer. Price **\$14.95**

**BUS EXTENDERS** Allow easy access to Apple II peripheral circuit cards. Price **\$19.95**

**SCOPE PROBES** Oscilloscope probes for use with the APPLESCOPE - BNC adapter. Price **\$29.95**

**SCOPE DRIVER** Advanced software for the Applescope system provided on 5 1/4" floppy disk. Available options include:

- Signal Averaging - Acquires 1 to 255 signal sweeps and displays the averaged result.
- Digital Volt Meter - Allows use as a real time DVM or use to measure points on an acquired sweep.
- Hard Copy - Uses graphics printer to produce hard-copy output of displayed traces.
- Disk Storage - Allows automatic storage and recover of acquired data on floppy disks.
- Spectrum Analyzer - Calculates and displays frequency spectrum of acquired data.

## BUS RIDER

### LOGIC ANALYZER for the APPLE II

The BUS RIDER circuit card silently rides the Apple II peripheral bus and allows real time tracking of program flow. Software provided on EPROM allows set up of trace parameters from the keyboard and read back of disassembled code after a program has been tracked.

- 32 bit by 1024 sample memory buffer
- Monitors Data and Address bus plus 8 external inputs
- Trigger on any 32 bit word or external trigger
- Pretrigger viewing

The BUS RIDER is an invaluable development tool for anyone working with Apple II or Apple II+ computers.

Price **\$295**

## RC ELECTRONICS INC.

7265 Tuolumne St., Goleta, CA 93117

(805) 968-6614

M/C

**Listing 2:** Using the positions determined from the gridded form, the FFTABL-I program can develop a control table that displays the field name for each piece of data, sets the maximum field length, and enters the exact line and column position for each data field.

```

10 *****
20 ***
30 PRINT: PRINT
40 PRINT " FFTABL-I.BAS"
50 PRINT " FillForm Table Program"
60 PRINT "Copyright 1981 by Elliam Assoc."
70 ***
80 *** This program Builds or Updates a
90 *** Control table file that is used
100 *** with FFORM-I.BAS
110 ***
120 *** MICROSOFT BASIC
130 *****
140
150 Set for 100 records
160
500 INITIALIZATION
510 *****
520 *** Dimension arrays, Set flags and Initialize**
530 *** variables.
540 *****
550
560 DIM LCL$(3), LNE$(100), COL$(100), LN$(100), FLDNA$(100)
570 FALSE%=0: TRUE%=-1
580 NOREC%=0: 'Max Number of Records
590 CTFLG%=FALSE% 'Record counter flag
600 RFL%=FALSE% 'Re-enter flag
610 UDT%=FALSE% 'File read flag
620 ERFLG%=FALSE% 'Error flag
630 DEF FNL$(QS)=LEFT$(A$,1)
640 CHD1$="Item Ln Col Fld"
650 CHD2$=" No No No Len Field Name"
660 INV$="Invalid": FIL$=""
670 LCL$(1)="Line No.": LCL$(2)="Column No.": LCL$(3)="Length"
680 CMDSS$(1)="VALID COMMANDS": CMDSS$(2)=" "
690 CMDSS$(3)="D# - Deletes item no. #"
700 CMDSS$(4)="I# - Allows record to be inserted at item no. #"
710 CMDSS$(5)="R# - Allows new item to replace item no. #"
720 CMDSS$(6)="L - Lists all items"
730 CMDSS$(7)="L# - Lists item no. #"
740 CMDSS$(8)="L#-# - Lists Range of Items"
750
1000 COMMAND MODE
1010 *****
1020 *** This section directs the control of the **
1030 *** program.
1040 *****
1050
1060 PRINT
1070 INPUT "Build Table, Update Table, List Table or END (B, U, L or E): ", A$
1080 IF FNL$(QS)="B" GOTO 1130
1090 IF FNL$(QS)="U" GOTO 1140
1100 IF FNL$(QS)="L" GOTO 1160
1110 IF FNL$(QS)="E" GOTO 7050
1120 GOTO 1060
1130 GOSUB 2190: GOTO 1050 'Build Mode
1140 GOSUB 1560: IF A$<"<" GOTO 1050 'Read table file
1150 GOSUB 4090: GOTO 1050 'Update Mode
1160 GOSUB 1560: IF A$<"<" GOTO 1050 'Read table file
1170 GOSUB 5860: GOTO 1050 'List file
1180
1500 READ CONTROL TABLE FILE
1510 *****
1520 *** This routine reads the sequential control **
1530 *** table file and places each field in the **
1540 *** appropriate array for updating.
1550 *****
1560
1570 IF UDT% THEN RETURN 'If file has been read ret
1580 INPUT "Drive (A or B): ", DRV$ 'Get drive for file
1590 IF DRV$<"<" THEN RETURN
1600 IF DRV$<"A" AND DRV$<"B" GOTO 1580
1610 INPUT "Enter Table Name: ", FIL$
1620 IF FIL$<"<" GOTO 1580
1630 OPEN "I", 1, DRV$+": "+FIL$+".TBL"
1640 PRINT "Reading {", FIL$, "}" Table
1650 FOR I%=1 TO 1000
1660 IF EOF(1) GOTO 1710
1670 INPUT #1, LNE$(I%), COL$(I%), LN$(I%)
1680 LINE INPUT #1, A$
1690 A$=MID$(A$, 2): FLDNA$(I%)=LEFT$(A$, LEN(A$)-1) 'Strip quotes
1700 NEXT 'from string
1710 NOREC%=I%-1 'Number of records
1720 PRINT: PRINT NOREC% "Table Entries Read"
1730 PRINT
1740 UDT%=TRUE% 'Set file read flag
1750 CLOSE #1 'Close file
1760 RETURN
1770
2000 BUILD CONTROL TABLE
2010 *****
2020 *** This routine builds and also is used to **

```

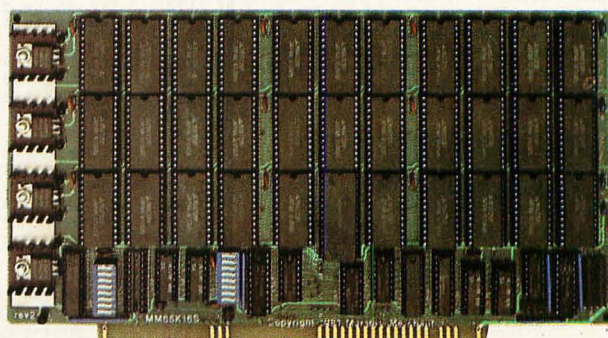
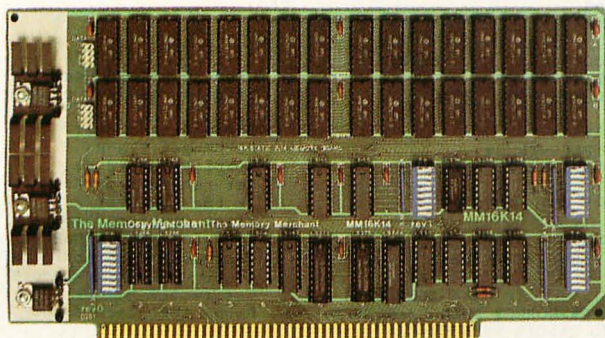
Listing 2 continued on page 226



# S-100 STATIC MEMORY BREAKTHROUGH

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All Memory Merchant's boards are shipped direct from stock, normally within 48 hours of receipt of your order.

### NO RISK TRIAL

We are so convinced that you will be absolutely delighted with our boards that we extend a no risk trial offer. After purchasing one of our boards, you may return it (intact) for any reason within 15 days after shipment and we will refund the purchase price.

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The reliability of our boards, through quality controlled production and proven performance, has enabled us to extend our warranty to a full 18 months. This includes a 6 month exchange program for defective units.

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Please send check, money order, VISA or MASTERCHARGE (add ICA#) with your order. Sorry, no C.O.D.'s. Specify model number, and quantity desired. Shipping and handling charge is \$5.00 per board. California residents add 6% Sales Tax. Credit card purchases may be telephoned to (415) 483-1008.

**OEM and DEALER inquiries invited.**



**14666 Doolittle Drive  
San Leandro, CA 94577  
(415) 483-1008**

### 64K RAM, Model MM65K16S

Cool running operation to 10 MHz

Ultra low-power consumption

Fully loaded 64K board draws:

Typ. 350 Ma. (Max. current 550 Ma.)

Bank Select Capability

Extended Addressing Capability

One 16K submodule equipped with a 2K window which may be located in any of the 2K segments

2716 (5V) EPROM Compatibility:

Programmed 2716 EPROM's may replace any or all of the RAM

Four independently addressable 16K submodules on one board organized as two pair of independent 32K banks or as one 64K Extended Address Page. Each 32K bank responds independently to phantom. Bank Select logic is compatible with either Cromemco Cromix\* or standard Bank Select software.

\*Cromix is a trademark of Cromemco.

New 16K (2K X 8) 150ns Static RAM

Runs on any S-100, 8-bit system

MPM Conversion Option: Write for details.

### 16K RAM, Model MM16K14

Bank Select Capability

Extended Addressing Capability

One 4K segment equipped with 1K windows

Four independent 4K X 8 byte segments

Uses field proven 2114 (1K X 4)

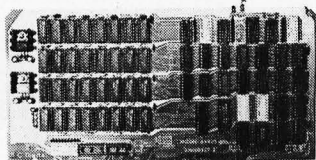
Low-power consumption (Typ. 1.3 Amps)

Runs on any S-100 8080, 4 MHz Z-80 or 5 MHz 8085 system.

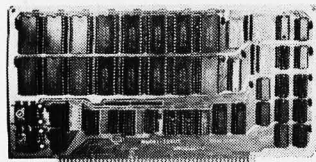
Prices, terms, specifications subject to change without notice.

Circle 233 on inquiry card.

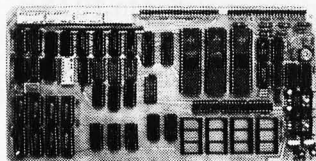


**S-100 Boards from S. C. Digital****64K DYNAMIC RAM 'Uniselect: 2'****features: Model 64KUS**

● 16 or 24 bit addressing. ● 8 bit data. ● Bank Select by SW settable Port, Bits in Two blocks. ● Two 32KB (or 128KB) addressing. ● Transparent refresh with delay lines, giving unlimited DMA, immune to Wait States, halts, resets. ● Fast access time - 220nsec from Smemr or Psync high, will run with Z80, Z8000 to 4mhz, 8080, 8085, 8088, 8086 to 5mhz without wait states. ● Provision to expand to 256KB using 64K by 1 chips.

**32K Static Ram 'Uniselect: 3'****features: Model 32KUS**

● Fully Static using 2k by 8 NMOS chips. ● 16 or 24 bit address. ● 8/16 bit wide data. ● Bank Select by port and bit in 32K block. ● Two 16K block addressing with window capability in 2k increments. ● EPROM can be mixed with RAM. ● Fast access - 250nsec from address valid - will run with Z80, Z8000 to 4mhz, 8080, 8085, 8088, 8086 or 68000 to 8mhz without Wait States. ● Provision for Battery Backup using NMOS or CMOS.

**I/O, Memory Interface 'Interface: 1'****features: Model 3SPC**

● 3 serials using UART, RS-232C or 20ma current loop. ● 1 Parallel I/O with hand shakes. ● 4k Ram, 4k EPROM (not supplied). ● Built in Kansas City Audio Cassette interface. ● Baud rate generator from 19.2kbaud to 110 baud.

**2K Z80 Monitor Program****available for M:3SPC**

features: many routines including breaker points, cassette record and play back . . . etc. Comes in 2 EPROMs and 1K RAM.

**Z80 CPU Board Model CPU1-Z80**

features: ● 2 or 4mhz clock. ● Jump on Reset ● 2K of EPROM (not supplied). ● 8 levels of prioritized vectored interrupts.

**16K Static Ram 'Uniselect: 1'****features: Model 16KUS**

● Fully static using 2114L-2, 200nsec chips. ● Bank Select by port and bit. ● 8 bit data, 16 bit address.

All boards conform to IEEE696/S100 specifications, fully socketed, screened legends, masks, Gold contacts. Guaranteed One Full year.

Model		List	Our Price
64KUS	with 64KB	A&T \$520	\$479
64KUS-16	with 16KB	A&T \$309	\$284
32KUS	with 32KB	A&T \$435	\$399
32KUS-16	with 16KB	A&T \$295	\$269
32KUS-N	no mem chips	A&T \$165	\$149
3SPC	with cassette	A&T \$249	\$229
3SPC-KC	with cassette	Kit	\$159
CPU1-Z80	with interrupt	A&T \$239	\$219
CPU1-Z80-K	no interrupt	Kit	\$149
16KUS-K	200 nsec chips	A&T	\$195
16KUS-K	200 nsec chips	Kit	\$175
2K Monitor	with 1K Ram		\$ 55

Delivery is within 3 working days. MC, Visa or COD orders accepted. Illinois residents add 5 1/4% sales tax.

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Phone: (312) 897-7749

Listing 2 continued:

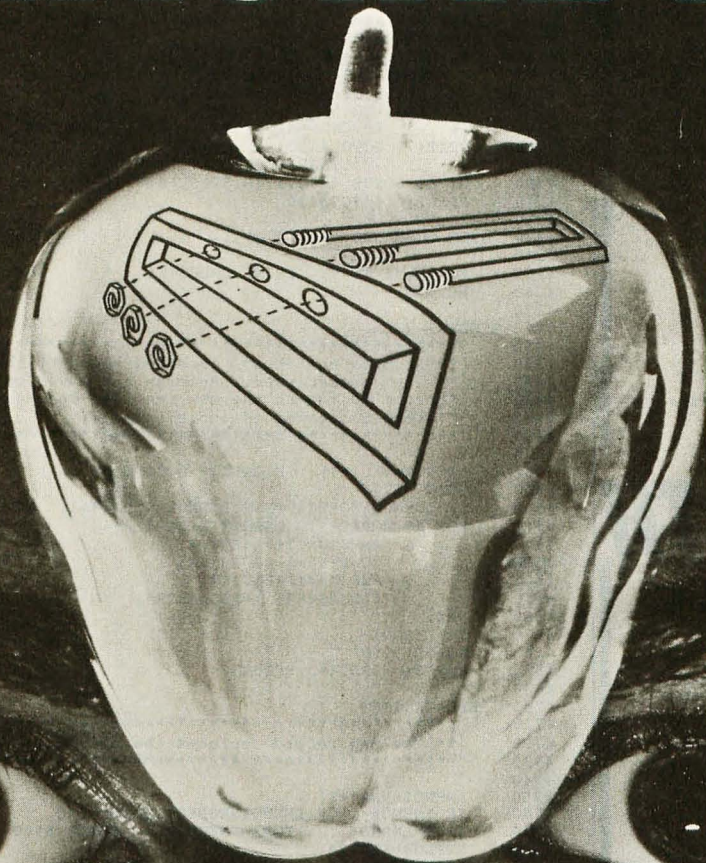
```

2030  *** update the control table. The user may  **
2040  *** go back and re-enter a previous field by **
2050  *** entering '<' or to any item no. by enter- **
2060  *** ing '<N' where 'N' is the item number.  **
2070  *** Data is entered as a string with a ', ' **
2080  *** as a required delimiter between fields. **
2090  *** An 'END' entry terminates the building of **
2100  *** a table. If entering the Build Mode from **
2110  *** the Update Mode entries will be added to **
2120  *** the end of the file. Entries are edited **
2130  *** for delimiters as well as sequential line **
2140  *** and column positions - also for overlapp- **
2150  *** ing fields. **
2160  *** A 'CHD' entry will cause a column heading **
2170  *** to be displayed. **
2180  *****
2190
2200  PRINT "<< BUILD MODE >>": PRINT
2210  PRINT CHD1$: PRINT CHD2$
2220  IF UDT% THEN C%=NOREC%: GOTO 2240
2230  C%=0
2240  C%=C%+1: C1%=C%
2250  RFL%=FALSE%: CTFLG%=TRUE%
2260  PRINT RIGHT$(" "+STR$(C%),4)+" ";
2270  LINE INPUT " ",A$
2280  IF LEFT$(A$,1)<"<" GOTO 2370
2290  CTFLG%=FALSE%
2300  IF LEN(A$)<1 THEN GOTO 2330
2310  C%=C%-1: IF C%<1 THEN C%=1
2320  GOTO 2260
2330  C%=VAL(MID$(A$,2)): IF C%<1 THEN C%=1
2340  IF UDT%=TRUE% AND C%>NOREC% THEN C%=NOREC%
2350  IF UDT%=FALSE% AND C%>C1% THEN C%=C1%
2360  RFL%=TRUE%: GOTO 2260
2370  IF A$="CHD" THEN PRINT CHD1$: PRINT CHD2$:
2380  IF A$="END" THEN RETURN
2390  FOR K%=1 TO 3: J%=INSTR(A$,"")
2400  IF J%>0 GOTO 2420
2410  PRINT INV$: "delimiter": GOTO 2260
2420  B$(K%)=LEFT$(A$,J%-1)
2430  A$=MID$(A$,J%+1)
2440
2450  B$(4)=A$
2460  FOR K%=1 TO 3
2470  FOR J%=1 TO LEN(B$(K%))
2480  IF MID$(B$(K%),J%,1)="0" AND MID$(B$(K%),J%,1)!="9" GOTO 2510
2490  PRINT INV$:
2500  PRINT LCL$(K%): GOTO 2260
2510  NEXT
2520
2530  NEXT
2540  IF EDFLG% THEN GOSUB 3260: IF ERFLG% GOTO 2260
2550  IF C%=1 GOTO 2560
2560  GOSUB 3060: IF ERFLG% GOTO 2260
2570  LNES(C%)=B$(1): COL$(C%)=B$(2)
2580  LN$(C%)=B$(3): FLN$(C%)=B$(4)
2590  UDT%=TRUE%
2600  IF CTFLG% THEN NOREC%=NOREC%+1
2610  IF RFL% THEN C%=C1%-1: RFL%=FALSE%
2620  IF EDFLG% THEN RETURN ELSE GOTO 2240
2630
2640  *****
2650  CHECK AGAINST PREV RECORD
2660  *****
2670  *** Test line numbers and column positions to **
2680  *** prevent backward movement and overlapping **
2690  *** fields. **
2700  *****
2710
2720  ERFLG%=FALSE%
2730  IF VAL(B$(1))>VAL(LNES(C%-1)) GOTO 3110
2740  PRINT "Line no. ("&B$(1)&") Less than Previous Line No. ("&LNES(C%-1)&")"
2750  GOTO 3390
2760  IF VAL(B$(1))>VAL(LNES(C%+1)) GOTO 3360
2770  IF VAL(COL$(C%-1))+VAL(LN$(C%-1))>VAL(B$(2)) GOTO 3140
2780  PRINT "Overlapping fields": GOTO 3390
2790  GOTO 3360
2800
2810  *****
2820  CHECK AGAINST NEXT RECORD
2830  *****
2840  *** Test line numbers and column positions to **
2850  *** prevent backward movement and overlapping **
2860  *** fields. **
2870  *****
2880
2890  IF C%=NOREC%+1 THEN RETURN
2900  IF C%>NOREC% AND EDFLG% THEN RETURN
2910  ERFLG%=FALSE%
2920  IF VAL(B$(1))<VAL(LNES(C%+1)) GOTO 3330
2930  PRINT "Line no. ("&B$(1)&") Greater than Next Line No. ("&LNES(C%+1)&")"
2940  GOTO 3390
2950  IF VAL(B$(1))<VAL(LNES(C%+1)) GOTO 3360
2960  IF VAL(B$(2))+VAL(B$(3))>VAL(COL$(C%+1)) GOTO 3360
2970  PRINT "Overlapping fields": GOTO 3390
2980  FOR K%=1 TO 3: IF B$(K%)="0" GOTO 3380
2990  NEXT: RETURN
3000  PRINT LCL$(K%): " can not be Zero"
3010  ERFLG%=TRUE%: RETURN
3020
3030  *****
3040  UPDATE
3050  *****
3060  *** In the Update Mode records may be Insert- **
3070  *** ed, Replaced, Deleted and Listed. Enter **
3080  *** the code letter for the function and the **

```



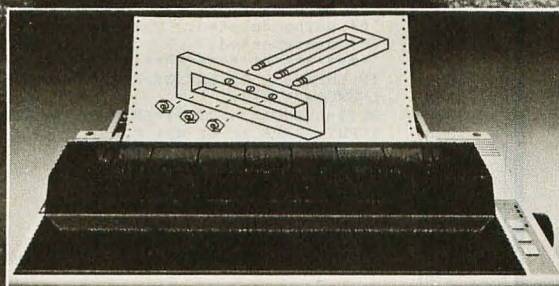
# IMAGINE IT..



## CAPTURE IT.

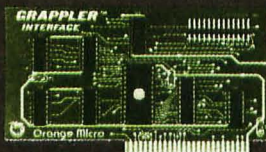
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Excellent full-screen Editor, structured & modular programming  
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THE NOTEPAD letter writer  
Optimized for your TRS-80 with keyboard repeats, upper/lower case display driver, full ASCII, single- & double-width graphics, etc.

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Interpreter AND compiler  
8080 Assembler  
(Z80 Assembler also available)  
Intermix 35- to 80-track disk drives  
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MMSFORTH UTILITIES DISKETTE: Includes FLOATING POINT MATH (L2 BASIC ROM routines plus Complex numbers, Rectangular-Polar coordinate conversions, Degrees mode, more), plus a full Forth-style Z80 ASSEMBLER, plus a powerful CROSS-REFERENCE to list Forth words by block and line. All on one diskette (requires MMSFORTH V2.0, 1 drive &amp; 32K RAM). \$39.95\*

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FORTH SPECIAL ISSUE, BYTE Magazine (Aug. 1980) we stock this collector's item for Forth users and beginners.....\$4.00\*

ORDERING INFORMATION: Software prices include manuals and require signing of a single system, single-user license. SPECIFY for Model I or Model III! Add \$2.00 S/H plus \$3.00 per MMSFORTH and \$1.00 per additional book; Mass. orders add 5% tax. Foreign orders add 20%. UPS COD, VISA &amp; M/C accepted; no unpaid purchase orders, please.

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61 Lake Shore Road, Natick, MA 01760  
(617) 653-6136

## Listing 2 continued:

```

4050  ** Item No. The "L" (list) by itself will  **
4060  ** list the whole Control Table. "L#" lists **
4070  ** Item #. "L#-#" lists a range of item Nos.**
4080  ****
4090
4100  PRINT: PRINT "<< UPDATE MODE >>": PRINT
4110  INPUT "Insert, Replace, Delete, List, END or ?(I#,R#,D#,L#-#,E or ?): ",A$
4120  EDFLG:=FALSE: PRINT
4130  IF FNLS(Q$)="E" THEN RETURN
4140  EDFLG:=TRUE: DPB$="D"
4150  CMD$=FNLS(Q$): A$=MID$(A$,2)
4160  FOR K%=1 TO 5
4170      IF CMD$=MID$("IRDL?",K%,1) GOTO 4190
4180  NEXT: GOTO 4110
4190      INSR REPL DELT LIST ?
4200  ON K% GOSUB 4470,4740,5060,5450,4240
4210  PRINT: GOTO 4110
4220
4230  LIST COMMANDS
4240
4250  FOR K%=1 TO 8: PRINT CMD$(K%): NEXT
4260  RETURN
4270
4280  INSERT ITEM
4290  ****
4300  ** Records are always inserted ahead of the **
4310  ** item number used. Records are moved up to**
4320  ** room to insert the new record. The Max **
4330  ** record counter is incremented. **
4340  ****
4350
4360  LNENO%=VAL(A$): IF LNENO%>0 GOTO 4500
4370  GOTO 5570
4380  IF LNENO%>NOREC% THEN LNENO%=NOREC%+1: GOTO 4570
4390  FOR K%=NOREC% TO LNENO% STEP-1
4400      LNE$(K%+1)=LNE$(K%)
4410      COL$(K%+1)=COL$(K%)
4420      LNS$(K%+1)=LNS$(K%)
4430      FLDNA$(K%+1)=FLDNA$(K%)
4440
4450  NEXT
4460  C%=LNENO%
4470  GOSUB 2260
4480  NOREC%=NOREC%+1:RETURN
4490
4500  REPLACE ITEM
4510  ****
4520  ** The new record replaces the old data **
4530  ****
4540
4550  LNENO%=VAL(A$)
4560  IF LNENO%<1 OR LNENO%>NOREC% GOTO 5570
4570  BOT%=LNENO%: TOP%=LNENO%: GOSUB 5940
4580  CTFLG:=FALSE
4590  C%=LNENO%
4600  GOSUB 2260
4610  RETURN
4620
4630  DELETE ITEM
4640  ****
4650  ** Records are moved down to overlay the item**
4660  ** being deleted. The Max record counter is **
4670  ** decremented. **
4680  ****
4690
4700  IF LNENO%<1 OR LNENO%>NOREC% GOTO 5570
4710  LNENO%=VAL(A$)
4720  BOT%=LNENO%: TOP%=LNENO%: GOSUB 5940
4730  INPUT "SURE (Y or N): ",A$
4740  IF FNLS(Q$)<>"Y" THEN RETURN
4750  FOR K%=LNENO% TO NOREC%
4760      LNE$(K%)=LNE$(K%+1)
4770      COL$(K%)=COL$(K%+1)
4780      LNS$(K%)=LNS$(K%+1)
4790      FLDNA$(K%)=FLDNA$(K%+1)
4800
4810  NEXT: NOREC%=NOREC%-1: RETURN
4820
4830  LIST ITEMS IN UPDATE MODE
4840  ****
4850  ** Lists All items, Single item or a range of**
4860  ** Items depending on the parameters entered **
4870  ****
4880
4890  PRINT: DPB$="D"
4900  IF A$="" THEN BOT%=1:TOP%=NOREC%: GOTO 5540
4910  J%=INSTR(A$,"-")
4920  IF J%=0 THEN LNENO%=VAL(A$): GOTO 5560
4930  BOT%=VAL(LEFT$(A$,J%-1))
4940  IF BOT%<1 THEN BOT%=1
4950  TOP%=VAL(MID$(A$,J%+1))
4960  IF TOP%>NOREC% THEN TOP%=NOREC%
4970  IF BOT%<TOP% THEN GOSUB 5940: RETURN
4980  GOTO 5570
4990  IF LNENO%<0 AND LNENO%<NOREC% GOTO 5580
5000  PRINT "Line No. out of Range": RETURN
5010  BOT%=LNENO%: TOP%=LNENO%
5020  GOSUB 5940: RETURN
5030
5040  LISTS or PRINTS RECORDS IN COMMAND MODE
5050  ****
5060  ** Lists or Prints the complete Control Table**
5070  ** This routine is also used by the Update **
5080  ** Mode. **
5090  ****
5100

```



Listing 2 continued:

```

5860
5870 PRINT: BOT%=1: TOP%=NOREC%:SCNT%=0:LCNT%=0 'Set list range for all
5880 INPUT "Display, Print or Both (D, P OR B): ",A$
5890 DPB$=A$: IF A$="<" THEN RETURN
5900 IF A$="D" THEN PRINT CHD1$: PRINT CHD2$: GOTO 5940
5910 IF A$<>"P" AND A$<>"B" GOTO 5880
5920 INPUT "Position Paper: c/r ",A$
5930 GOSUB 6090 'Heading
5940 FOR I%=BOT% TO TOP%
5950 AS=RIGHT$(" "+STR$(I%),4)+". " 'Record number
5960 IF DPB$="P" GOTO 5990
5970 PRINT AS;LNE$(I%);TAB(13-LEN(COL$(I%)));COL$(I%);
5980 PRINT TAB(18-LEN(LN$(I%)));LN$(I%);TAB(22);FLDNA$(I%)
5990 IF DPB$="D" GOTO 6050
6000 LPRINT AS;LNE$(I%);TAB(13-LEN(COL$(I%)));COL$(I%);
6010 LPRINT TAB(18-LEN(LN$(I%)));LN$(I%);TAB(22);FLDNA$(I%)
6020 LCNT%=LCNT%+1: IF LCNT%<=62 GOTO 6050 'Test for end of page
6030 FOR K%=LCNT% TO 66: LPRINT 'End of page spacing
6040 NEXT: LCNT%=0: GOSUB 6090'Page heading
6050 IF DPB$="P" GOTO 6070
6060 SCNT%=SCNT%+1: IF SCNT%=18 THEN SCNT%=0: INPUT "c/r ",A$
6070 NEXT: RETURN
6080
6090 'HEADING
6100 LPRINT: LPRINT
6110 LPRINT "Control Table {",FIL$,"}":LPRINT
6120 LPRINT CHD1$: LPRINT CHD2$: LPRINT 'Column Headings
6130 LCNT%=7: RETURN 'Set line counter
6140
7000 'WRITE CONTROL TABLE FILE
7010 *****
7020 *** This routine writes the Control Table data**
7030 *** to a sequential file. ***
7040 *****
7050
7060 IF A$="<" GOTO 1060
7070 INPUT "Write File (Y or N): ",A$
7080 IF A$="Y" GOTO 7100
7090 IF A$<>"N" GOTO 7070 ELSE GOTO 8060
7100 INPUT "Write to Drive (A or B): ",DRV$
7110 IF DRV$="<" GOTO 7070
7120 IF FIL$="" GOTO 7170
7130 IF DRV$<>"A" AND DRV$<>"B" GOTO 7100
7140 INPUT "Same File Name (Y or N): ",A$
7150 IF A$="<" GOTO 7100
7160 IF A$="Y" GOTO 7190
7170 INPUT "Enter Table Name: ",FIL$
7180 IF FIL$="<" GOTO 7100
7190 OPEN "O",1,DRV$+";"+FIL$+".TBL"
7200 PRINT "Writing {",NOREC%,"} Records"
7210 FOR I%=1 TO NOREC%
7220 PRINT #1,LNE$(I%);";";COL$(I%);";";
7230 PRINT #1,LN$(I%);";";
7240 WRITE #1,FLDNA$(I%)
7250 NEXT
7260 CLOSE #1
7270
8000 'AGAIN
8010 *****
8020 *** This routine allows the user to Build or **
8030 *** Update another Control Table without ***
8040 *** leaving the program. ***
8050 *****
8060
8070 INPUT "Again (Y or N): ",A$
8080 IF A$="N" THEN END
8090 IF A$<>"Y" GOTO 8070
8100 INPUT "Same Control Table (Y or N): ",A$
8110 IF A$="<" GOTO 8070
8120 IF A$="N" THEN NOREC%=0:UDT%=FALSE%:GOTO 1060 'Reset Max ctr & flag
8130 IF A$<>"Y" GOTO 8100 ELSE GOTO 1060

```

Text continued from page 222:

the program issues only a carriage return and waits for a response. If your printer includes a line feed, you will have to crank the form back one line before repositioning. When the form is aligned satisfactorily, the program prints the grid on the form. Figure 2 shows a sample standard purchase-order form that has been gridded with the FFGRID-1 program.

### Building a Forms-Control Table

Using the gridded form, you can determine the line and column posi-

tions to be used in building a control table (see listing 2). At the same time, the maximum length for each field can be specified.

Listing 3 shows the control table created with the FFTABL-1 program for the purchase-order form. This control-table file will also be used by the FFORM-1 program to display the field names for data entry, determine the maximum field length, and provide the line and column position for each data field.

FFTABL-1, like the other programs, scrolls up from the bottom of

Listing 3: A sample control table developed using the purchase order form shown in figure 1.

Control Table {PO}

Item No	Ln	Col	Fld No	Len	Field Name
1.	4	10	30		Company Name
2.	4	44	8		Contact:
3.	4	57	25		Contact name
4.	5	10	30		Company Address
5.	5	57	14		Contact Phone
6.	6	10	30		City, State, Zip
7.	9	10	30		PO to Company
8.	9	58	25		Ship to Name
9.	11	10	30		PO to Address 1
10.	11	58	25		Ship to Address
11.	12	10	30		PO to Address 2
12.	13	10	30		PO to City,
					State, Zip
13.	13	58	25		Ship to City,
					State, Zip
14.	17	2	12		For
15.	17	20	14		Req.No.
16.	17	37	12		How Ship
17.	17	51	8		Date Required
18.	17	60	8		Terms
19.	17	70	11		Date
20.	20	5	5		Ordered 1
21.	20	12	5		Received 1
22.	20	20	42		Item Desc 1
23.	20	64	7		Price 1
24.	20	74	7		Unit 1
25.	22	5	5		Ordered 2
26.	22	12	5		Received 2
27.	22	20	42		Item Desc 2
28.	22	64	7		Price 2
29.	22	74	7		Unit 2
30.	24	5	5		Ordered 3
31.	24	12	5		Received 3
32.	24	20	42		Item Desc 3
33.	24	64	7		Price 3
34.	24	74	7		Unit 3
35.	26	5	5		Ordered 4
36.	26	12	5		Received 4
37.	26	20	42		Item Desc 4
38.	26	64	7		Price 4
39.	26	74	7		Unit 4
40.	28	5	5		Ordered 5
41.	28	12	5		Received 5
42.	28	20	42		Item Desc 5
43.	28	64	7		Price 5
44.	28	74	7		Unit 5
45.	30	5	5		Ordered 6
46.	30	12	5		Received 6
47.	30	20	42		Item Desc 6
48.	30	64	7		Price 6
49.	30	74	7		Unit 6
50.	32	5	5		Ordered 7
51.	32	12	5		Received 7
52.	32	20	42		Item Desc 7
53.	32	64	7		Price 7
54.	32	74	7		Unit 7

the screen, so no cursor positioning is required.

When the FFTABL-1 program comes up in the command mode, you are given the choice of building a new control table, updating or changing an existing control table, listing an existing control table to the screen or printer, or ending the program and writing out the control table to disk. The program always returns to the command mode after each mode is finished.

**Build Mode:** When the Build mode is entered, a column heading is dis-



played with item number 1 on the next line. After each entry is made, the item number is incremented by one. An entry consists of the line number, the column position, the maximum field length, and a field name (see figure 3). The field name is displayed by the FFORM-1 program for data entry. Commas are required as delimiters between fields.

While in the Build mode you may reenter the previous field by entering a < or go back to any previously entered item by entering <N, where N is the item number. The program issues an error message if N is less than 1 or greater than the largest item

number. The Build Mode is terminated by entering the word END.

**List Mode:** After the Build mode is ended, you may list the control table on the screen or print the table. The program lists 18 lines on the screen and then requests a carriage return before listing the next 18 lines. If printed, the program takes care of column headings for a 66-line page. A previously prepared control table can also be read and listed.

**Update Mode:** In the Update mode you can:

- **Insert:** Enter the code IN, with N being the item number of the record

to be inserted. If I9 is used, item 9 will be renumbered to 10, 10 will be moved to 11, etc. The inserted record becomes item 9. All previous records are moved up to make room for the insertion. Item numbers greater than N will be incremented. To append records to the end of the file use I to insert an item number greater than the highest item number in the file or return to the Command mode and use the Build mode.

- **Replace:** The entry of RN will allow a new entry for item N. This entry replaces the existing record with the new record.

- **Delete:** DN causes item N to be deleted. All records will be moved down. Item numbers greater than the N used will be decremented.

- **List:** The list commands allow you to L all items, L# a single item, or L#-# a range of items (# is the number of an item).

- **End:** END terminates the Update mode and returns the program to the Command mode.

## Valid Entries

The fields that make up a record are entered as a string, then broken up into individual fields. This allows use of < and END, which would never work in BASIC if the line-number field was a numeric field. The program edits each record to make sure it is valid by

- Checking for commas as delimiters between fields

- Checking for line or column positions less than 1

- Checking to make sure that line numbers increment (for example, you cannot insert line number 20 ahead of line number 15)

- Checking to make sure that fields on a line do not overlap (a field starting in column position 20 that is 20 characters long cannot be followed by a field starting in column 30)

- Issuing error messages when the record is not valid and displaying the same item number again for a correct entry

Once a control table is built, it can be changed by running the control-

Figure 2: The FFGRID-1 program prints a grid over your form that allows you to determine the coordinates for the various data fields.

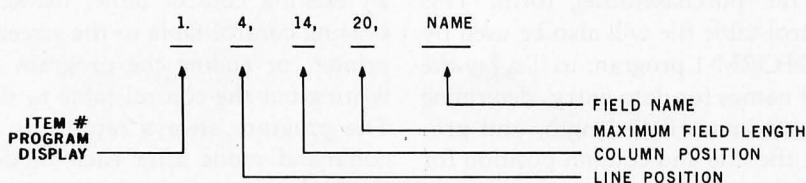


Figure 3: In the Build mode, the FFTABL-1 program prompts you to enter the data for each field.



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table file through the FFTBAL-1 program. Use the Update mode to insert, delete, or replace the line and column positions that need adjusting so that the data fields will fit properly on the form.

### Filling in a Form

After building a control table, the FFORM-1 program is used to enter the data to be printed on the form (see listing 4). When the program is loaded it goes into the Command mode and gives you the following options:

- **Build:** Build new data arrays; these may be printed or written to disk.
- **Change:** Change the data in the data array or data file (fix errors).
- **List:** List the data-array file, showing the line and column position and data for each field. The listing may be displayed or sent to the printer. You can specify that the whole file, a single field, or a range of fields be listed.
- **Print:** Print out the form on the printer or display the data on the screen as it would look on the form.

While in the Command mode, the FFORM-1 program functions the same as the other two programs. User options include:

**Build:** The control table that provides the line and column positions and field names is first read into an array. The program then displays the first field number and field name, together with underscores corresponding to the maximum field length. You enter the data for that field and hit the carriage return. The program will display the field number and field name for the second field. For blank fields, a carriage return is entered. The use of the < and <N for reentering data is the same as in the FFTBL-1 program. If you want to stop before reaching the end of the table, enter <END to go back to the Command mode.

Form designers have been known to ignore the fact that typewriters and printers are generally unable to han-

**Listing 4:** The FFORM-1 program prints out the form or allows you to enter or change data in the data file.

```

10 *****
20 **
30 PRINT: PRINT
40 PRINT " FFORM-1.BAS"
50 PRINT "FillForm File and Print Program"
60 PRINT "Copyright 1981 by Elliam Associates"
70 **
80 ** This Program Builds a Form File
90 ** and/or Fills Out a Form - uses
100 ** a control table built with
110 ** FFTBL-1
120 **
130 *****
140
150 'Program set for 100 fields
160
500 'INITIALIZATION
510 *****
520 ** Dimension arrays, Set flags and Initialize**
530 ** variables
540 *****
550
560 DIM LCL$(3),LNE$(100),COL$(100),LNS$(100),FLDNA$(100)
570 DIM FLNE$(100),FCOL$(100),FDTA$(100)
580 FALSE%=0: TRUE%=-1
590 NOREC%=0
600 NODTA%=0
610 CTFGL%=FALSE%
620 RFL%=FALSE%
630 UDT%=FALSE%
640 FUDT%=FALSE%
650 EDFLG%=FALSE%
660 CNTR%=0
670 OK%=0
680 C1%=0
690 C2%=0
700 LNO%=0
710 SCNT%=0
720 LCNT%=0
730 DEF FNLS(Q$)=LEFT$(A$,1)
740 CHD1$=" Item Lne Col"
750 CHD2$=" No No No Field Data"
760
1000 'COMMAND MODE
1010 *****
1020 ** This section directs the control of the
1030 ** program
1040 *****
1050
1060 PRINT
1070 PRINT "Build File, Change File, List File, Print File or END ";
1080 INPUT "(B,C,L,P or E):",A$
1090 CMDS=A$
1100 IF FNLS(Q$)="B" GOTO 1160
1110 IF FNLS(Q$)="C" GOTO 1170
1120 IF FNLS(Q$)="L" GOTO 1180
1130 IF FNLS(Q$)="P" GOTO 1190
1140 IF FNLS(Q$)="E" GOTO 7050
1150 GOTO 1060
1160 FUDT%=FALSE%: GOSUB 2170: GOTO 1060 'Reset Read data flag
1170 GOSUB 4100: GOTO 1050
1180 GOSUB 4570: GOTO 1050
1190 GOSUB 8490: GOTO 1050
1200
1500 'READ CONTROL TABLE
1510 *****
1520 ** This routine reads the sequential control
1530 ** table file and places each field in the
1540 ** appropriate array for use in building a
1550 ** data file.
1560 *****
1570
1580 IF UDT% THEN RETURN
1590 INPUT "Control Table Drive (A or B): ",A$
1600 DRV$=A$: IF DRV$="<" THEN RETURN
1610 IF DRV$<>"A" AND DRV$<>"B" GOTO 1590
1620 INPUT "Enter Table Name: ",FIL$
1630 IF FIL$="<" GOTO 1590
1640 OPEN "I",1,DRV$+"."+FIL$+".TBL"
1650 PRINT: PRINT "Reading {";FIL$;"} Table"
1660 FOR I%=1 TO 1000
1670 IF EOF(1) GOTO 1720
1680 INPUT #1,LNE$(I%),COL$(I%),LNS$(I%)
1690 LINE INPUT #1,A$
1700 A$=MID$(A$,2): FLDNA$(I%)=LEFT$(A$,LEN(A$)-1) 'Strip quotes
1710 'from string
1720 NEXT
1730 NOREC%=I%-1
1740 PRINT: PRINT NOREC% "Table Entries Read"
1750 PRINT: UDT%=TRUE%
1760 CLOSE #1
1770 RETURN
2000 'BUILD DATA FILE
2010 *****
2020 ** This routine builds a data file. It is
2030 ** also used to change a data field. The
2040 ** user may go back and re-enter a previous
2050 ** field by entering "<" or to any field

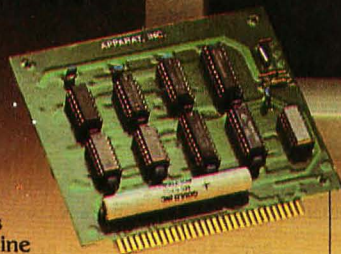
```

Text continued on page 236

Listing 4 continued on page 234



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### Listing 4 continued:

```

2060  *** number by entering '<N' where 'N' is the **
2070  *** field number. Each field name is display- **
2080  *** ed followed by a number of underscores. **
2090  *** The number of underscores corresponds to **
2100  *** maximum length of the field. If the **
2110  *** entry is to long an error message is dis- **
2120  *** played and the field name is redisplayed. **
2130  *** If no data is to be entered in a field **
2140  *** then enter a c/r. To escape before all **
2150  *** fields are filled enter '<END'. **
2160  *****
2170
2180  GOSUB 1570                                'Read control tbl file
2190  PRINT "<< BUILD MODE >>":                PRINT
2200  IF FUdT% THEN C%=NODTA%:                GOTO 2220    'If data file in memory
2210  C%=0
2220  C%=C%+1:                                C1%=C%      'Increment counter & save
2230  RFL%=FALSE%:                            CTFLG%=FALSE% 'Preset flags
2240  PRINT TAB(LEN(FLDNAS(C%))+9);
2250  PRINT STRINGS(VAL(LNS(C%)), " ");CHRS(13);
2260  PRINT RIGHT$(" "+STR$(C%),4)+". ";FLDNAS(C%);" "; 'Tab & Display underscores
2270  LINE INPUT " ",AS                      ' then c/r to left
2280  IF AS%=<"END" THEN NODTA%=C%-1: RETURN    ' " "; field name
2290  IF AS%=<"STOP" GOTO 2400                'enter data
2300  IF LEFT$(AS,1)<>"<" THEN CTFLG%=TRUE%: GOTO 2380    'Check for re-enter
2310  IF LEN(AS)<>1 THEN GOTO 2340            'Test for record no.
2320  C%=C%-1:                                IF C%<1 THEN C%=1 'Decrement field ctr
2330  GOTO 2240
2340  C%=VAL(MID$(AS,2)):                    IF C%<1 THEN C%=1 'Get field number
2350  IF UDT%=TRUE% AND C%>NOREC% THEN C%=NOREC% 'Range test field no.
2360  IF UDT%=FALSE% AND C%<1% THEN C%=C1%   ' " " " "
2370  RFL%=TRUE%:                            GOTO 2240    'Set re-enter flag
2380  IF LEN(AS)<=VAL(LNS(C%)) GOTO 2400      'Test length
2390  PRINT "<<T o o L o n g>>": GOTO 2240    'Error message
2400  FLNE$(C%)=LNE$(C%):                    FCOL$(C%)=COL$(C%) 'Store line & col posn
2410  FDTA$(C%)=AS                          'Store data
2420  FUdT%=TRUE%:                            IF C%=NOREC% THEN RETURN 'Set no read data flag
2430  IF RFL% THEN C%=C1%-1: RFL%=FALSE%     'Reset counter & flag
2440  IF EDFLG% THEN RETURN ELSE GOTO 2220
2450
4000  'CHANGE
4010  *****
4020  *** This routine allows a user to change the **
4030  *** in an existing file by field number. If **
4040  *** no field number is supplied from the **
4050  *** Command mode the program requests a field **
4060  *** number. The old data is displayed so the **
4070  *** user can see what was in the field. Also **
4080  *** the line and column position are displayed**
4090  *****
4100
4110  GOSUB 9050:                            IF AS%=<"<" THEN RETURN    'Read Data file
4120  GOSUB 1570:                            IF AS%=<"<" THEN RETURN    'Read Ctl tbl
4130  EDFLG%=FALSE%                          'Reset edit flag
4140  AS=MID$(CMD$,2)                        'Get field no.
4150  IF VAL(AS)<1 OR VAL(AS)>NOREC% THEN INPUT "Record #: ",AS
4160  IF AS%=<"<" THEN RETURN                'No change - return
4170  IF VAL(AS)>0 AND VAL(AS)<=NOREC% GOTO 4190 'Range test field no.
4180  PRINT "Line No. out of Range": GOTO 4150 'Display error msg.
4190  EDFLG%=TRUE%                          'Set edit flag
4200  C%=VAL(AS):                            DPB$="D"          'Set Rec# & Display
4210  BOT%=C%:                                TOP%=C%          'Set Rec #
4220  GOSUB 4850:                            GOSUB 2240:        RETURN    'List/Enter Chg
4230
4500  'LIST CONTROL
4510  *****
4520  *** This section sets up the parameters for a **
4530  *** listing. All fields, single field or a **
4540  *** range of fields depending on the **
4550  *** entered. **
4560  *****
4570
4580  GOSUB 9050:                            IF AS%=<"<" THEN RETURN    'Read Data file
4590  DPB$="D":                                AS=MID$(CMD$,2)
4600  IF AS%="<" THEN BOT%=1:TOP%=NODTA%:    GOTO 4640    'No prams - All
4610  J%=INSTR(AS,"-"):IF J%=0 THEN LNEO%=VAL(AS): GOTO 4660
4620  BOT%=VAL(LEFT$(AS,J%-1)):              IF BOT%<1 THEN BOT%=1 'Test range
4630  TOP%=VAL(MID$(AS,J%+1)):              IF TOP%>NODTA% THEN TOP%=NODTA%
4640  IF BOT%<TOP% THEN GOSUB 4770: RETURN    'Go list
4650  GOTO 4670
4660  IF LNEO%>0 AND LNEO%<=NODTA% GOTO 4680 'Test range of fields
4670  PRINT: PRINT "Line No. out of Range": RETURN 'Error message
4680  BOT%=LNEO%: TOP%=LNEO%: GOSUB 4770: RETURN
4690
4700  'LIST DATA FILE
4710  *****
4720  *** Displays or prints the selected part of **
4730  *** the data file. Field numbers, line nos, **
4740  *** column numbers and data are output. A **
4750  *** Column heading is available when printing.**
4760  *****
4770
4780  PRINT
4790  INPUT "Display, Print or Both (D, P OR B): ",AS
4800  PRINT: DPB$=AS:                            IF AS%=<"<" THEN RETURN
4810  IF AS%="D" THEN PRINT CHD1$: PRINT CHD2$: GOTO 4850
4820  IF AS<>"P" AND AS<>"B" GOTO 4790
4830  INPUT "Position Paper: c/r ",AS
4840  GOSUB 8910                                'Heading
4850  SCNT%=0
4860  FOR I%=BOT% TO TOP%
4870      AS=RIGHT$(" "+STR$(I%),4)+". "      'Field number

```



## Listing 4 continued:

```

4880 IF DPB$="P" GOTO 4940
4890 PRINT A$;FLN$(I%);TAB(16-LEN(FCOL$(I%)));
4900 PRINT FCOL$(I%);TAB(20);FDTA$(I%)
4910 IF DPB$<>"D" GOTO 4950
4920 SCNT%=SCNT%+1: IF SCNT%<18 GOTO 5000 'Screen line count
4930 INPUT "C/r ",A$: SCNT%=0: GOTO 5000
4940 IF DPB$="D" GOTO 5000
4950 LPRINT A$;FLN$(I%);TAB(16-LEN(FCOL$(I%)));
4960 LPRINT FCOL$(I%);TAB(20);FDTA$(I%)
4970 LCNT%=LCNT%+1: IF LCNT%<62 GOTO 5000 'Test for end of page
4980 FOR K%=LCNT% TO 66: LPRINT 'End of page spacing
4990 NEXT: LCNT%=0: GOSUB 8910 'Heading
5000 NEXT: RETURN
5010
7000 'WRITE DATA FILE
7010 *****
7020 '** This routine writes the data in the arrays**
7030 '** to a sequential file. **
7040 *****
7050
7060 GOSUB 1560 'Get control table
7070 INPUT "Write File (Y or N): ",A$
7080 IF A$="Y" GOTO 7100
7090 IF A$<>"N" GOTO 7070 ELSE GOTO 8080
7100 INPUT "Write to Drive (A or B): ",A$
7110 DRV$=A$: IF A$="C" GOTO 7070
7120 IF DRV$<>"A" AND DRV$<>"B" GOTO 7100
7130 INPUT "Enter File Name: ",FIL$
7140 IF FIL$="C" GOTO 7100
7150 IF FIL$="" THEN FIL$=FFIL$
7160 OPEN "O",1,DRV$+":"+FIL$+ ".FILE"
7170 PRINT "Writing {" ;NODTA% ;"} Records"
7180 FOR I%=1 TO NODTA%
7190 PRINT #1,FLN$(I%);";";COL$(I%);";"; 'Line & col Posn
7200 WRITE #1,FDTA$(I%) 'Data field
7210 NEXT
7220
7230 CLOSE #1
7240
8000 'AGAIN
8010 *****
8020 '** This section allows the user to: **
8030 '** 1. Build another data file. **
8040 '** 2. Print another data file. **
8050 '** 3. Change another data file. **
8060 '** without leaving the program. **
8070 *****
8080
8090 INPUT "Again (Y or N): ",A$
8100 IF A$="N" THEN END
8110 IF A$<>"Y" GOTO 8090
8120 INPUT "Same Control Table (Y or N): ",A$
8130 IF A$="C" GOTO 8090
8140 IF A$="N" GOTO 1060
8150 IF A$<>"Y" GOTO 8120
8160 INPUT "Same Data File (Y or N): ",A$
8170 IF A$="C" GOTO 8120
8180 IF A$="N" THEN FUDT%=FALSE%: GOTO 1060
8190 IF A$<>"Y" GOTO 8160 ELSE GOTO 1070
8200
8400 'PRINT CONTROL
8410 *****
8420 '** This routine uses a line counter LNO%, **
8430 '** when the line number C1% in the record **
8440 '** matches LNO% the data is printed at TAB **
8450 '** position C2%. After the first data field **
8460 '** is printed the program allows the user to **
8470 '** realign the form if necessary. **
8480 *****
8490
8500 GOSUB 9050: IF A$="C" THEN RETURN 'Read data file
8510 PRINT
8520 INPUT "Display, Print or Both (D, P OR B): ",A$
8530 FDPB$=A$: IF A$="C" THEN RETURN
8540 IF FDPB$<>"D" THEN LPRINT 'Clear Printer Buffer
8550 IF FDPB$<>"D" THEN INPUT "Position Form: ",A$
8560 'C1%=LINE, C2%=SPOSN, CNTR%=PRINT LINR COUNTER
8570 CNTR%=0: OK%=0: LNO%=0
8580 C1%=VAL(FLN$(CNTR%)): C2%=VAL(FCOL$(CNTR%))
8590 IF LEN(FDTA$(CNTR%))=0 GOTO 8750
8600 IF C1%-LNO%=1 GOTO 8640
8610 LNO%=LNO%+1
8620 IF FDPB$="D" OR FDPB$="B" THEN PRINT: GOTO 8600 'Blank line
8630 IF FDPB$="P" OR FDPB$="B" THEN LPRINT: GOTO 8600 'Blank line
8640 GOSUB 8840 'Print Field
8650 ON OK% GOTO 8750 'Continue or align
8660 PRINT
8670 IF FDPB$="D" THEN A$="Y": GOTO 8730
8680 INPUT "Alignment OK, Ck Next Field or Quit (Y, C or Q): ",A$
8690 IF A$<>"Q" GOTO 8730
8700 IF FDPB$<>"D" THEN PRINT
8710 IF FDPB$<>"D" THEN LPRINT
8720 RETURN
8730 IF A$<>"Y" AND A$<>"C" GOTO 8670 'Test valid entry
8740 OK%=0: IF A$="Y" THEN OK%=1 'Set continue flag
8750 CNTR%=CNTR%+1: IF CNTR%<=NODTA% GOTO 8580 'Inc Ctr & Test EOF
8760 PRINT: IF FDPB$<>"D" THEN LPRINT: RETURN
8770
8780 'PRINT FIELD
8790 *****

```

Listing 4 continued on page 236

## LET'S TALK EPROM PROGRAMMING AND THE S-100 BUS!

You say your eprom programming needs are varied, but your engineering budget doesn't permit the purchase of that \$5,000-\$7,000 stand-alone programmer?

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elmhurst, il. 60126  
(312) 530-8992

\*CP/m  
trademark  
Digital  
Research, Inc.

**ads**



```

8800  ** Check for <STOP to allow for repositioning**
8810  ** the form. Print data field at line number**
8820  ** and column position.
8830  *****
8840  /
8850  IF FDTA$(CNTR%)<>"<STOP" GOTO 8870          'Test for reposn
8860  INPUT "Reposition Form c/r ",Z$:          RETURN
8870  IF FDPB$<>"P" THEN PRINT TAB(C2%);FDTA$(CNTR%); 'Display field
8880  IF FDPB$<>"D" THEN LPRINT TAB(C2%);FDTA$(CNTR%); 'Print field
8890  RETURN
8900  /
8910  'HEADING
8920  LPRINT: LPRINT
8930  LPRINT "Data File {";FFIL$;"}": LPRINT
8940  LPRINT CHD1$: LPRINT CHD2$: LPRINT          'Print column heading
8950  LCNT%=7: RETURN                            'Set line counter
8960  /
9000  'READ DATA FILE
9010  *****
9020  ** This routine reads a data file and places **
9030  ** the data in appropriate arrays.
9040  *****
9050  /
9060  IF FUDT% THEN RETURN
9070  INPUT "Form File Drive (A or B): ",AS: DRV$=AS
9080  IF DRV$="<" THEN RETURN
9090  IF DRV$<>"A" AND DRV$<>"B" GOTO 9070
9100  INPUT "Enter Form File Name: ",FFIL$
9110  IF FFIL$="<" GOTO 9070
9120  OPEN "I",1,DRV$+";"+"FFIL$+".FLE"
9130  PRINT: PRINT "Reading {";FFIL$;"} Form File"
9140  FOR I%=1 TO 1000
9150      IF EOF(1) GOTO 9200
9160      INPUT #1,FLNES(I%),FCOL$(I%)
9170      LINE INPUT #1,AS
9180      AS=MID$(AS,2): FDTA$(I%)=LEFT$(AS,LEN(AS)-1) 'Strip quotes
9190                                          'from string
9200  NEXT
9210  NODTA%=I%-1
9220  PRINT: PRINT NODTA% "Form File Entries Read": PRINT
9230  FUDT%=TRUE%
9240  CLOSE #1
9250  RETURN

```

Text continued from page 232:

dle forms with unusual line spacing. If the form has unusual line spacing, the print program can be stopped so the form can be realigned: just enter <STOP for the field name and the program will stop on the selected line at the selected column. Reposition Form will be displayed on the screen.

Once back in the Command mode the data can be changed, listed, written to disk, displayed on the screen, or sent to the printer.

**Change:** If the change command is used when the program starts up, you will be requested to enter the file name for a previously saved data file and control table. If you enter C while using the FFORM-1 program, it will request the field number to change. If you enter CN, the program will display the current data for field N. You can then change the data for that field and the program will be ready for the next command.

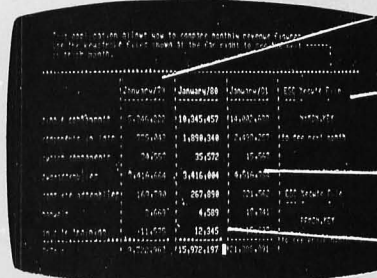
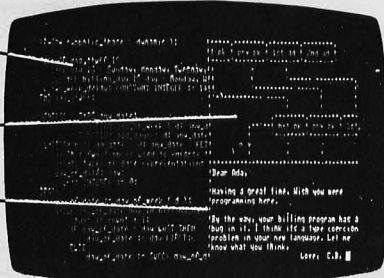
**List:** The list command, like the change command, can be used with a

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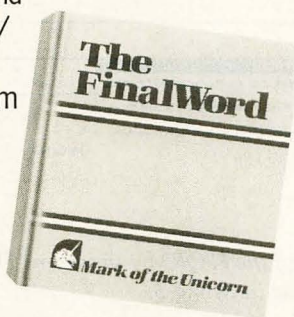
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# Introducing The FinalWord!

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Features	The FinalWord	WordStar	Magic Wand
Full-Screen Editing	Yes	Yes	Yes
Directory Access while Editing	Yes	Yes	Yes
Simultaneous Printing while Editing	Yes	Yes	Yes
External Commands while Editing	Yes	Yes	No
Video Highlighting	Yes	Yes	No
Automatic Footnotes	Yes	No	No
User-Defined Commands	Yes	No	No
Multiple File Editing	Yes	No	No
Deletion Recovery	Yes	No	No
Supports Multiple Printers	Yes	No	No
Crash Recovery	Yes	No	No
Dynamic Include Files	Yes	No	Yes
<b>Suggested Retail Price</b>	<b>\$300</b>	<b>\$495</b>	<b>\$395</b>

The FinalWord requires a 56K CP/M system and video terminal with cursor positioning character sequences. It is presently available in 8" standard format for the TRS-80 Model II, Vector Graphics and Altos Systems. There are compatible versions for the HP-125, Xerox 820, Cromemco, Micropolis, Ohio Scientific and Dynabyte Systems, and there are 5 1/4" versions for the Heath/Zenith Z-89, Northstar, Apple and Superbrain. **Coming Soon: The FinalWord for the IBM Personal Computer.**

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Call for delivery schedule.  
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# Mark of the Unicorn



**Listing 5:** A sample data file developed with the FFORM-1 program. The data is also shown in the completed form in figure 4.

Data File {RIDE}

Item No	Line No	Col No	Field Data
1.	4	10	Easyoff Riding Stables
2.	4	44	Contact:
3.	4	57	Fred Horseman
4.	5	10	123 Pony Lane
5.	5	57	(555) 123-4567
6.	6	10	Mustang, AZ 10001
7.	9	10	Mavrick Supply Company
8.	9	58	Easyoff Riding Stables
9.	11	10	456 Whitehorse Blvd.
10.	11	58	Back Gate
11.	12	10	Quarterhoss, AZ 10002
12.	13	10	
13.	13	58	Mustang, AZ 10001
14.	17	2	Stock
15.	17	20	S78-9
16.	17	37	Livery Wagon
17.	17	51	Y'terday
18.	17	60	net 10
19.	17	70	Mo/Da/Yr
20.	20	5	12
21.	20	12	
22.	20	20	Soft Pillows
23.	20	64	3.75
24.	20	74	each
25.	22	5	1
26.	22	12	
27.	22	20	Saddle Glue
28.	22	64	37.50
29.	22	74	case
30.	24	5	1
31.	24	12	
32.	24	20	Saddle sore liniment
33.	24	64	27.80
34.	24	74	box

data file or used to list the fields just completed. All the fields may be listed by entering L; a single field can be listed using LN; a range of fields can be listed using LN-N, where N is the field number (see listing 5 for a sample data file).

The listing of the sample data file created with the FFORM-1 program contains the item number, line position, column position, and data to be printed at that location.

**Print:** The print command allows you to display either the array data (created by FFORM-1) or field data, formatted as it would look on the form, or the field data can be used to fill in the form on the printer.

When a printout of a form is requested, the program first asks you to position the form, then prints the first field and allows you to reposition the form. It can then print the next field and stop for forms alignment check, print the rest of the form, or quit. If a data field contains <STOP>, the program will stop to allow you to reposition the form. Figure 4 shows the completed purchase order that was printed using sample data fields.

**Saving the Data:** In the Command

ORDER NO  
**6731**

PURCHASE ORDER

Easyoff Riding Stables  
 123 Pony Lane  
 Mustang, AZ 10001

Contact: Fred Horseman  
 (555) 123-4567

TO Mavrick Supply Company  
 ADDRESS 456 Whitehorse Blvd.  
 CITY Quarterhoss, AZ 10001

SHIP TO Easyoff Riding Stables  
 ADDRESS Back Gate  
 CITY Mustang, AZ 10001

FOR Stock		REQ. NO. S78-9	HOW SHIP Livery Wagon	DATE REQUIRED Y'terday	TERMS net 10	DATE Mo/Da/Yr
ORDERED	QUANTITY	PLEASE SUPPLY ITEMS LISTED BELOW			PRICE	UNIT
1	12	Soft Pillows			3.75	each
2	1	Saddle Glue			37.50	case
3	1	Saddle sore liniment			27.80	box
4						
5						
6						
7						

**IMPORTANT**

OUR ORDER NUMBER MUST APPEAR ON ALL INVOICES, PACKAGES, ETC.  
PLEASE NOTIFY US IMMEDIATELY IF YOU ARE UNABLE TO SHIP COMPLETE ORDER BY DATE SPECIFIED.

Rediforms 15 144

PLEASE SEND COPIES OF YOUR INVOICE WITH ORIGINAL BILL OF LADING.

PURCHASING AGENT

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**Figure 4:** The result of the FFORM-1 program. The information on this form is the same as that in the data file in listing 5.

mode, the program can be ended by entering E. You then have the option of writing the data arrays to a disk file for future use or rerunning the program.

Depending upon your needs, you can add a number of enhancements to

**These programs work best when there is constant use of a standard form, such as insurance forms, applications, or government paperwork.**

these programs that will make them easier to use, for example:

- Multiple page forms with more than 100 data fields
- Command letters in either uppercase or lowercase
- Left- or right-justified data fields
- String or numeric fields
- An alert to any entry-required fields
- Print constants from the control table

- Special editing and range checking of data

- Use of the INP statement instead of INPUT to eliminate the need of the carriage return for completely filled fields

- Making a mask that looks similar to the form to be filled in and placing it over the screen—then filling in the data in the mask fields (this enhancement requires the use of a display that has an addressable cursor)

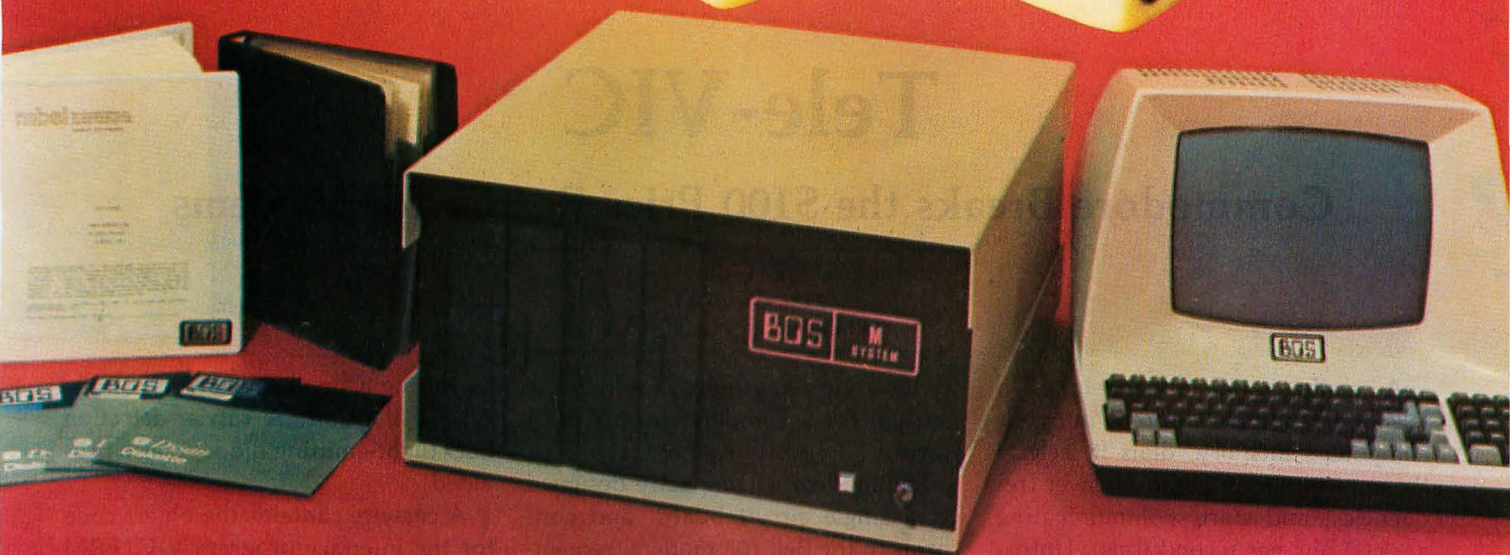
Most of these enhancements could be implemented by expanding the number of fields in the control table, then adding more code to support them.

### Summary

The Fill Forms System is a relatively simple set of programs that can be used in a wide variety of situations. They work particularly well in situations where a standard form is required—for insurance agencies, application forms, or government documents. The more complex the form and the more frequently it is used, the more time you'll save by using this system. ■



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"How about Word Processing?"

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**Yes, if it's CP/M\*\*\* compatible, almost certainly!**

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"Well, this is important...will service be available when I need it?"

**Yes, with a large dealer network, strategically placed maintenance depots, and fast factory repair turn-around.**

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# Product Description

## Tele-VIC

### Commodore Breaks the \$100 Price Barrier for Modems

---

Max Lebow  
2121 Locust St.  
Philadelphia, PA 19103

---

A really good modem takes a telephone number stored in your computer's memory, dials it, selects the appropriate originate/answer frequencies, and starts communicating at 9600 bits per second (bps). Unfortunately, a really good modem can also cost as much as a good used car.

If you are willing to dial your own telephone, set a manual switch to select originate/answer frequencies, and settle for 300 bps, Commodore's new modem may be an inexpensive solution. In fact, for the price of a moderately good 1200-bps modem, Commodore will sell you its modem and a VIC-20 home computer to go with it.

The modem is the VICMODEM. It is contained in a slim plastic case with an edge connector at one end and a modular telephone jack (for the *hand-set* cord) at the other. The edge connector attaches directly to the VIC-20, which has a special telecommunications slot to accept this modem or Commodore's RS-232 interface (see photo 1). (The VIC-20 is named for the Video Interface Chip, which provides the necessary interface between the computer and a television set. The VIC-20 has built-in connectors for a television (RF) and a video monitor. It also has a type-

writer-style keyboard, which is unusual for a computer in this price range.)

The modem is compactly designed on a single circuit board and conforms to the Bell 103 modem frequencies. It uses Motorola modem integrated-circuit chips and has a crystal to ensure frequency stability. Selection of originate or answer frequencies is accomplished manually

by setting a small slide switch on the side of the unit. A carrier-detection LED (light-emitting diode) is also provided.

A cassette contains the object code for the interface program VICTERM I. The features included in this software are impressive. They include:

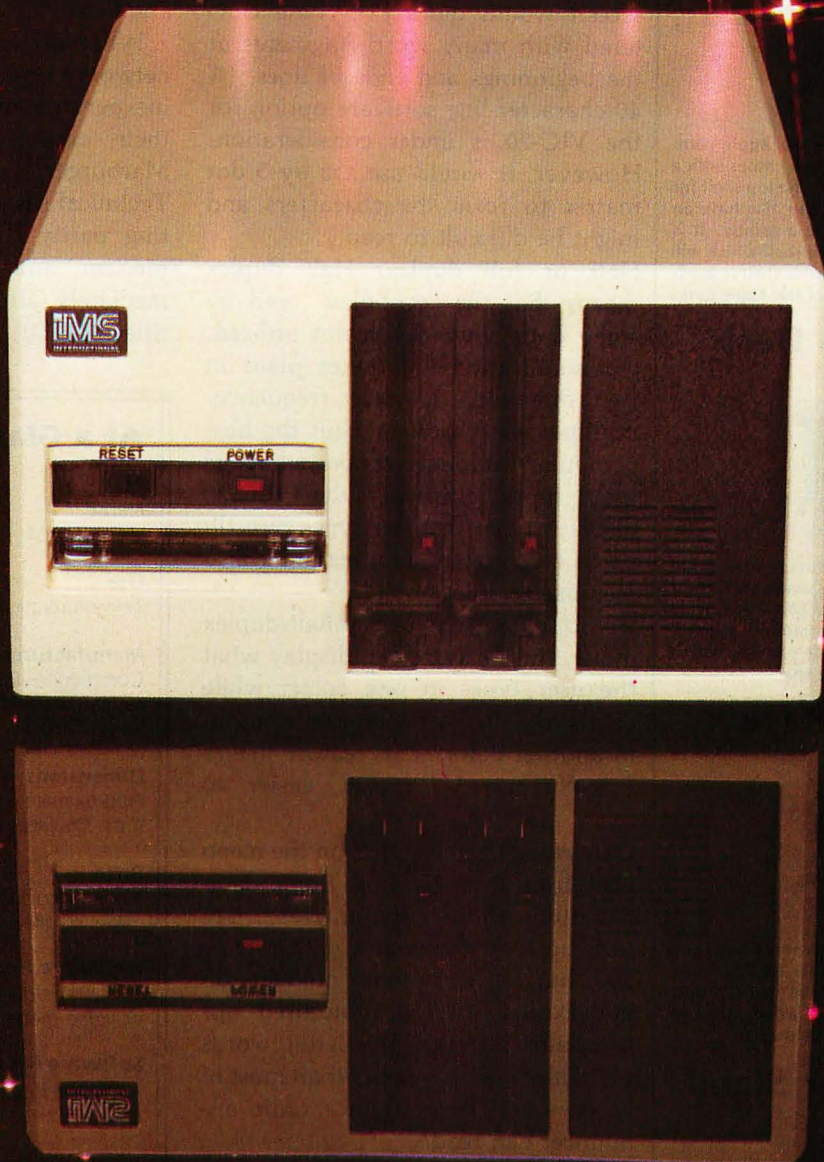
**Word wrap:** If the word at the end of a line is too long to fit on that line, it



**Photo 1:** This low-cost modem for Commodore's VIC-20 home computer takes a modular plug from a telephone handset and plugs directly into VIC-20's telecomputing slot. The modem shown here is a prototype with a provisional model number.



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Configuration shown includes two slimline double sided, double density drives, 40 M byte Winchester subsystem with tape back-up.

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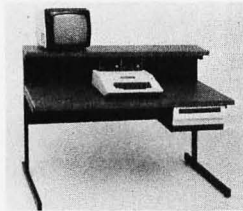
CP/M & MP/M, TM of Digital Research • TurboDOS, TM of Software 2000 • FMS-80, TM of DJR Associates • WORDSTAR, TM of MICROPRO • ACCOUNTING PLUS, TM of SOFTWARE DIMENSIONS

Circle 186 on inquiry card.



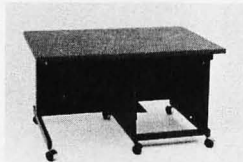
# CHOOSE...

## Choose an Apple Desk



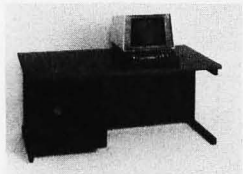
A compact Bi-Level desk ideal for the Apple computer system. This 42" x 29½" desk comes with a shelf to hold two Apple disk drives. The top shelf for your TV or monitor and manuals can also have an optional paper slot to accommodate a printer. It is shown here with the optional Corvis shelf which will hold one Corvis disk drive. The Corvis shelf is available on the 52" x 29½" version of the Apple desk.

## Choose a Micro Desk



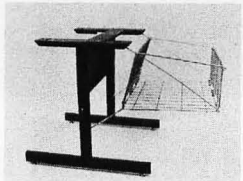
The Universal Micro desk accommodates the S-100 type microcomputers. The desk is available in four sizes: 17.75 inch, 19.06 inch, and 20.75 inch wide openings with 24 inch front-to-rear mounting space. The fourth size is a 20.75 inch wide opening with a 26.50 inch front-to-rear mounting space.

## Choose a Mini Rack



Mini racks and mini micro racks have standard venting, cable cut outs and adjustable RETMA rails. Choose a stand alone bay or a 48", 60", or 72" desk model in a variety of colors and wood tones. A custom rack is available for the Cromemco.

## Choose a Printer Stand



The Universal printer stand fits the:

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### ELECTRONIC SYSTEMS FURNITURE COMPANY

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Carson, California 90746  
Telephone: (213)538-9601

## Product Description

is whisked to the beginning of the next line. This feature is particularly useful for the VIC-20 with its maximum line length of 22 characters. Without this word-wrap feature, the screen would quickly become cluttered with many word fragments at the beginnings and ends of lines. (A 40-character-line software option for the VIC-20 is under consideration. However, it would use a 3 by 5 dot matrix to form the characters and might be difficult to read.)

**Half or full duplex:** Half duplex means that the "echoplex" used by some data networks is not utilized. Communication still takes place in two directions on two frequency-multiplexed "channels," but the host computer no longer echoes what the user types. Instead, the VIC-20 displays what the user types directly on its own screen. This feature is also menu-selectable.

**Color separation:** In the half-duplex mode, the software can display what the user types in one color, while displaying the host computer's output in another color. This feature makes user-computer dialogues easier to read.

**Data rate:** This selection on the menu goes from 0 to 300 bps. Some data-communications aficionados may turn up their noses at a data rate of 300, but most economy modems do not exceed it. Three hundred bps translates into 300 five-letter words per minute. This is faster than most of us type and faster than a radio announcer can read.

**Five parity settings:** These are also menu-selectable. They are: even parity, odd parity, parity set to one (mark), parity set to zero (space), and no parity (eighth bit treated as data). This feature goes a long way toward assuring that the modem will make the VIC-20 compatible with most 8-bit-byte transmission schemes. More on this feature later.

By now, a cartridge with even more features should be available, priced around \$50.

If you decide not to buy the VICTERM I software, Commodore provides a free printed copy of a

short BASIC program with the modem (see listing 1). You key this program in before dialing and eventually record it on your own cassette. It has none of the features listed above for the VICTERM I software.

What do engineers at large data networks recommend when using an inexpensive modem to connect to their expensive computers? Mike Marburger, Tymnet's Eastern Region Technical Manager, recommends setting parity to zero (space) on the modem and typing control-H immediately after the Terminal Identifier (TID) to disable Tymnet's

### At a Glance

#### Name

VICMODEM

#### Use

Telecommunications for the VIC-20

#### Manufacturer

Commodore Business Machines Inc.  
681 Moore Rd.  
King of Prussia, PA 19406

#### Dimensions

Approximately 15 by 10 by 3.75 cm (6 by 4 by 1½ inches)

#### Price

\$109.95 (includes \$9.95 VICTERM I cassette software)

#### Hardware Needed

VIC-20, modular telephone, television set or video monitor, cassette recorder

#### Software Needed

VICTERM I cassette software or cartridge equivalent

#### Hardware Options

If you already own an acoustic coupler, it can be used with Commodore's RS-232 interface

#### Features

Direct connection to VIC-20 and telephone, crystal control, carrier-detect LED, originate/answer switch. With VICTERM I: word wrap, color separation (see text), menu-selectable data rate, parity options, cursor (on/off)

#### Documentation

User-friendly, step-by-step, illustrated manual

#### Audience

Anyone desiring an inexpensive telecommunication device



# Pascal Computer Design

Volume No. 4

PENN YAN, NEW YORK

25 CENTS Cheap

## IMP Debuts

**A Generation Beyond  
MuMath and FORTRAN**

Penn Yan-Programmer/Engineer John Clarke has released his IMP (Instant Mathematical Programming) for use with all UCSD p-System machines, as well as for CP/M users with Pascal/M. The program, which was introduced at \$225, permits anyone (yes, a non-programmer) to generate sophisticated Pascal programs to solve complex linear and non-linear equations.

### IMP Writes It

The IMP software first simplifies an algebraic problem statement (entered in simple text form), then writes a Pascal source program which, when compiled, gives the user a solution. The compiled program then permits the user to *Interactively* redefine constants or variables, or to maximize given parameters. Reviewers claim this system may replace FORTRAN as the engineer's computer standard.

## TURNKEY CHEAPER THAN CP/M

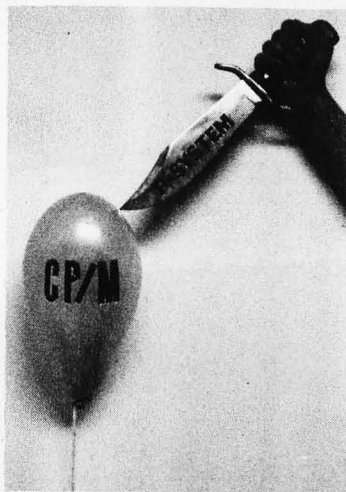
**Eliminate Need for Operating  
System Boot to Run  
Applications Approach (End  
Users Relieved)**

P-System Turnkey Packages are now available for applications developers to distribute with their programs. The software allows the end-user to "Boot and Run" without needing to learn about operating system commands. Full backup, editing and file handling capabilities also available at a fraction of the full system cost. This should prove to be a boon to systems houses...and it's cheaper than CP/M!

## LOGICALC (TM) moves "Calc" Software to UCSD Environs

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spreadsheet capability to all  
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Penn Yan-Logicalc (TM) has swept the Pascal world by storm. Only \$295 a complete package.



## RADIO SHACK II, III GET p-SYSTEM

**Now Can Share Programs  
with Apple, DEC and IBM**

Penn Yan-PCD Systems, who originally installed the p-System on the TRS-80 Model II have announced release of the complete system for the TRS-80 Model III. The p-System requires a 48K Model III with 2 disk drives. Now Radio Shack users can write programs compatible with Apple, Commodore, IBM (Personal Computer) and DEC machines (and vice versa).

A spokesman from the company noted that p-System software for DEC, Altos, Terak and Apple are already available from PCD Systems, Inc.

## Chapin Refuses to Reveal True Meaning of CPR

Penn Yan- Chip Chapin, who recently released his CPR "text formatter" refuses to reveal the true meaning of his new program's title.

CPR, which was designed for use with the UCSD p-System operating system software, takes raw text files produced from the Editor and formats them for printing. At \$195, CPR provides sophisticated word processing capabilities for a fraction of the cost.

So, when someone mentions CPR, don't think "first aid", think "text aid".

Now available at PCD Systems, Inc.

§CP/M is a tm of Digital Research  
‡DEC, PDP-11, LSI-11 & RT-11 are tm  
of Digital Equipment Corp.

\*MuMath is a tm of Microsoft

\*p-System is a tm of the Regents of  
California

†TRS Model II, III & TRSDOS are tm of  
the Tandy Corp.

★Z-80 is a tm of Zilog Corp.

## UCSD p-System To Burst CP/M's Balloon

**Experts predict 8-Bit to 16-Bit Portability Crucial**

*Support from IBM, Texas Instruments, Phillips, Hewlett  
Packard, Commodore Announced*

San Diego- Sources close to the battle predict that recent Version IV.O release and the master design that allows programs compiled on an 8-bit machine to run unchanged on the new 16-bit micros will give the p-System the "industry standard" status presently enjoyed by CP/M. They say that SofTech and PCD Systems have come up with the most viable system for the 80's.

Cross assemblers and "Pseudo-Code" allow programs developed on an 8-bit 6502 (such as Apple or Commodore) to be transported to a 16-bit 8088 (IBM) or LSI-11 (DEC) in **OBJECT CODE FORM**. A program can be executed without change on dozens of different machines with any common terminal.

**Structured Programming lowers Maintenance Costs**

P-System structured languages give developers powerful tools. A complete implementation of Pascal (plus many useful extensions) is available, as is FORTRAN-77, which supports the ANSI-77 subset for that language. A new BASIC compiler and a full range LISP interpreter round out the high level languages available. The structured approach to programming eliminates maintenance headaches which plague present users of standard BASIC and FORTRAN systems.

**Speed No Longer an Issue**

Linkage of Code segments in assembly language and/or use of the **NATIVE CODE** generators give compact code *without the sacrifice of speed* expected from p-Code interpretation. One can have one's cake and eat it too!

**Dynamic Memory Management**

Virtual operating system characteristics with nearly unlimited overlaying of program segments allows the user to run larger programs than other microcomputer operating systems. Program chaining, print spooling, 128K addressing capability and efficient use of system library units, universal screen control coding, and many peripherals configurations are fully supported. Command files, asynchronous I/O processing, p-Code debugger, procedural cross referencer and many more capabilities are being hailed by thousands of users.

**Cross Assemblers, File  
Conversion Transfer**

A complete set of native code generating cross assemblers generate absolute or relocatable code for the Z-80, Z-8, 8080, PDP-11, LSI-11, 6502, 6800, 6809 and 9900 microprocessors and are available through PCD Systems. File conversion programs for transferring data between TRSDOS, CP/M, RT-11, Microengine and IBM 3741 formats and p-System format add depth to system capabilities.

**Complete Portable  
Environment**

The standard p-System still includes that amazing screen editor (with its programming and word processing modes), file handler, interpreter, formatter, backup and configuration programs, and your choice of compiler. PCD Systems together with UCSD and SofTech have advanced the state of the art!

## 20% Off List

Penn Yan-PCD Systems is giving purchasers 20% off SofTech Microsystems suggested list price for those who buy a complete UCSD Development System by July 1st. Operating System, File Handler, Screen Editor (with word processing capabilities) system Library, Assembly Code Linker, Pascal Compiler and full documentation over 1000 pages is being sold for only \$600 complete. Compare other systems of this power and capability at three times the price!

## For a Catalog of UCSD p-System and Applications Software

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P O Box 143

Penn Yan, NY 14527

(315) 536-7428

(or stop in, Penn Yan is no stranger than Armonk)

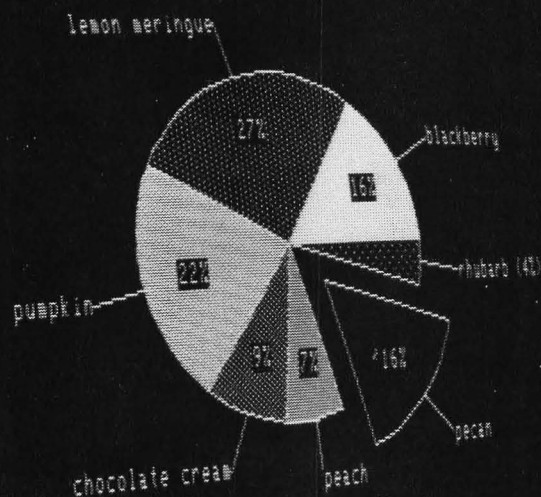
Circle 307 on Inquiry card.



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	NORTH STAR ADVANTAGE	IBM PERSONAL COMPUTER	APPLE III
MICROPROCESSOR(S)	Z-80A Central processor 8035 Auxiliary processor	8088 processor	6502A processor
GRAPHICS DISPLAY RESOLUTION	640 x 240 pixels	640 x 200 pixels	560 x 192 pixels
DUAL FLOPPY DISC CAPACITY	720K bytes	320K bytes	280K bytes
CONVENIENT DESKTOP PACKAGE*	Yes, all in one enclosure	No, 3 enclosures	No, 3 enclosures
BUSINESS GRAPHICS SOFTWARE INCLUDED?	Yes	No	No
CP/M COMPATIBLE?	Yes	Partial	No
LANGUAGES SUPPLIED BY MANUFACTURER	Graphics BASIC, PASCAL, COBOL, FORTRAN, C	BASIC, PASCAL	BASIC, PASCAL
APPLICATIONS S/W PACKAGES SUPPLIED BY MANUFACTURER	10 packages	5 packages	5 packages
SELF-TEST DIAGNOSTIC	Yes	Yes	No
NATIONAL ON SITE SERVICE	Yes	No	No
MANUFACTURER SUPPLIED PRINTERS	Letter quality/matrix (136 columns)	Matrix (80 columns)	Letter quality/matrix (80 columns)
RETAIL PRICE PER KILOBYTE OF DISK STORAGE	\$5.55	\$11.17	\$15.57

\*Professional configuration: Dual Floppy Disks, Monochrome Display, Keyboard, CPU, 64K bytes (or minimum) RAM Memory, and Printer Interface.  
Source: Dataquest and Manufacturer's Literature, November 1981.

FOLLOW THE STAR

**NorthStar**<sup>TM</sup>

Circle 281 on Inquiry card.



## Product Description

**Listing 1:** A simple BASIC program that allows the Commodore VIC-20 to communicate using the modem. VICTERM I, a more sophisticated program, is available at extra cost.

```

100 OPEN5,2,3,CHR$(6):DIMF(255),T(255)
210 FORJ=32TO64:T(J)=J:NEXT:T(13)=13:T(20)=8:RV=18:CT=0
220 FORJ=65TO90:K=J+32:T(J)=K:NEXT:FORJ=91TO95:T(J)=J:NEXT
240 FORJ=193TO218:K=J-128:T(J)=K:NEXT:T(146)=16:T(133)=16
260 FORJ=0TO255:K=T(J):IFK<>0THENF(K)=J:F(K+128)=J
270 NEXT:PRINT"J
300 GET#5,A$:SR=ST:IFA$=""ORSR<>0THEN310
305 PRINT" II"CHR$(F(ASC(A$)))":IFF(ASC(A$))=34THENPRINTCHR$(34):
306 GOTO300
310 PRINTCHR$(RV)" II":GETA$:IFA$<>""THENPRINT#5,CHR$(T(ASC(A$)))
315 CT=CT+1:IFCT=8THENCT=0:RV=164-RV
320 IF(PEEK(37151)AND64)=1THEN320
330 GOTO300

```

default (automatic) echo state. Tymnet can, at the interface to a host computer (not a terminal or home computer), routinely strip parity coming in from terminals and microcomputers and put on whatever type of parity the host computer requires.

General Electric Information Services Company operates a network similar to Tymnet, although GE's is much larger. In fact, it is the largest international data-communications network in the world. Robert McCalley, manager of the communications and distribution system, recommends setting the modem to half duplex and no parity (treating the eighth bit as data) before logging on.

Keith Boyer, a spokesman for Compuserve's technical services, noted that although *any* parity setting will put ASCII characters on the screen, the eighth bit must be sendable and receivable as data in order for Compuserve's A and B file-transmission protocols to work properly. These protocols are used for important functions such as downloading programs to user memory. Also, transmission of some graphics characters requires the eighth bit. The "no parity" selection on the VICTERM I menu should be selected when using the A and B protocols or graphics programs.

As this article was being completed, The Source had some information for VIC users in its Commodore Business Machines database.

The VICMODEM was developed under the watchful eyes of Michael Tomczyk. The development process took four months from start to finish, he said in a recent interview. The toughest part was bringing it in at the right price. Tomczyk, who has an astute sense of the marketplace for home computers, assessed the future of the modem this way: "We think this modem may sell as many VICs as the game cartridges."

With a growing number of giant publishing firms gearing up to supply electronic newspapers, videotex, and other home data products, he may well be right. ■

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# Lowercase Descenders for the Epson MX-70

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Bruce Piggott  
35 Beverley Rd.  
Stevenage, Hertfordshire  
SG1 4PR, England

---

Like most home-computer owners, I wanted a printer and, like most, couldn't afford one. But as prices began to fall, I gradually realized I could afford the Epson MX-70.

The MX-70 uses ordinary paper and has a graphics mode, but unfortunately it does not do lowercase descenders. This didn't worry me too much because most of the printing I wanted to do was program listings.

However, after working with the printer, I realized that although the MX-70 has eight print wires, it uses only seven in text mode. That meant lowercase descenders would be possible by switching to the graphics mode at the right time and using all eight print wires to create the lowercase letters.

Strangely enough, the MX-70 can print true descenders mechanically, but electronically the option was not available. I decided to write a machine-language program to modify the output.

The technique is to have a small program that examines the output of a printing routine. It looks at the ASCII (American Standard Code for Information Interchange) character in the microprocessor's A register to see if it is a lowercase letter with descender (e.g., g, j, p, q, or y). If one of those letters is not in that register, then the program jumps to

the standard output routine and prints the character in the normal way.

If, however, the letter requires a lowercase descender, the program switches the printer into the graphics mode and outputs a string of data that drives the printing pins to construct the improvised character (see listing 1).

The program assumes that the printer controller card is in slot 1. The equates (EQU) in lines 19, 20, and 21 must be changed for other slots: for slot 2, add hexadecimal 100 to the numbers, for slot 3, add hexadecimal 200, and so on.

If the character style is not to your liking, it can be changed by modifying the appropriate data string. The format is 5 dots wide and 8 dots deep, with the first byte defining the left side of the character and with the most significant bit at the top. The data string must end in a zero, as this is the delimiter for the program.

The program can also be extended to modify other characters or create some that are not in the standard ASCII set, for example:

- to change the number sign (#) to the English pound sign (£)
- to intercept normally unprintable codes (0 through 7) and print graphics
- to print Chinese characters

Plan the character you wish to design on graph paper. Convert the vertical columns into hexadecimal values using the tables in the MX-70 operation manual (remember the top bit is most significant). Then insert the resulting string into the source code in the DATA1 file (line 93), and insert the representative ASCII code into the "match" string (line 87). If you add a string at the end of the DATA1 file, you must also place the matching ASCII code at the end of the match string.

The program resides at hexadecimal 300 (decimal 768) and this address will have to be entered into the printer driver program.

Anyone planning to use this technique should expect that the operation of the MX-70 will seem a little strange at first. Whenever the MX-70 enters the graphics mode, it completes printing whatever is in the buffer up to that point, then backsteps to print the graphics. Consequently, the speed of the printer will slow down proportional to the number of lowercase letters with descenders. For this reason, I use the routine only for the final copy.

But the combination of the MX-70 and this program has saved me over \$150 compared to the price of the MX-80. And now I also have the use of the graphics mode. ■



**Listing 1:** *The Lowercase Descender program for the MX-70 and Apple II. Not only can you get true lowercase descenders, but you can program your own characters.*

```

SOURCE FILE: MX-70
0000:      1 *****
0000:      2 * LOWER CASE DESCENDERS FOR MX-70
0000:      3 *
0000:      4 * PROGRAM INTERCEPTS LOWER CASE :- G,J,P,Q,Y AND
0000:      5 * USING BIT MODE GRAPHICS, CONSTRUCTS TRUE
0000:      6 * DESCENDING CHARACTERS.
0000:      7 *
0000:      8 * PROGRAM ASSUMES THAT PRINTER INTERFACE-
0000:      9 * IS IN SLOT ONE. FOR OTHER SLOTS CHANGE-
0000:     10 * PRINTER, POUT AND PSense EQUATES.
0000:     11 * EG. FOR SLOT TWO ADD HEX. 100 TO ALL THREE EQUATES.
0000:     12 *
0000:     13 * BRUCE PIGGOTT. 6/20/81
0000:     14 *
0000:     15 *****
0000:     16 *
FF4A:     17 SAVE      EQU  $FF4A      :SAVE ALL REGISTERS
FF3F:     18 RESTORE EQU  $FF3F      :RESTORE ALL REGISTERS
C102:     19 PRINTER EQU  $C102
C090:     20 POUT      EQU  $C090
C1C1:     21 PSense   EQU  $C1C1      :SWITCHED ROM LOCATION
0000:     22 *
0000:     23 * MAIN PROGRAM ENTRY POINT
0000:     24 *
----- NEXT OBJECT FILE NAME IS MX-70.OBJ0
0300:     25          ORG  $300
0300:20 4A FF     26 ENTER   JSR  SAVE      : THIS ROUTINE SAVES ALL
0303:     27 *                      REGISTERS BUT DESTROYS THE
0303:     28 *                      CHARACTER IN THE 'A' REG.
0303:A5 45     29          LDA  $45      : REPLACE CHAR. FROM IT'S STORE.
0305:A2 04     30          LDX  #4       : SET UP X AS COUNTER FOR CHAR. SCAN
0307:D0 6E 03   31 LOOP1    CMP  MATCH,X  :COMPARE CHAR WITH MATCH LIST + X
030A:F0 09     32          BEQ  MODIFY    :IF IN LIST,X REG TELLS WHICH
030C:CA       33          DEX
030D:10 F8     34          BPL  LOOP1     : IF X NOT < 0
030F:20 3F FF   35          JSR  RESTORE   : IT WAS NOT IN LIST SO RESTORE
0312:4C 02 C1   36          JMP  PRINTER  :-- AND GO TO STANDARD ROUTINE
0315:     37 *
0315:     38 *****
0315:     39 *
0315:     40 * THE CHARACTER HAS BEEN IDENTIFIED AS G,J,P,Q OR Y
0315:     41 * THE X REGISTER IDENTIFIES WHICH.
0315:     42 * FIRST STEP IS TO MULTIPLY X BY 6 SO THAT IT CAN BE USED
0315:     43 * AS AN INDEXED OFFSET TO THE DATA LIST.
0315:     44 *
0315:8A       45 MODIFY   TXA          :PUT X IN A TO ALLOW MANIPULATION
0316:0A       46          ASL  A          : DOUBLE A
0317:8D 6D 03   47          STA  SUM      :STORE RESULT
031A:0A       48          ASL  A          : QUADRUPLE A
031B:18       49          CLC          : CLEAR CARRY FOR NEXT ADD
031C:6D 6D 03   50          ADC  SUM      : 4XA + 2XA = 6XA
031F:48       51          PHA          : SAVE RESULT FOR LATER
0320:     52 *
0320:     53 * NOW PUT PRINTER IN BIT MODE FOR 6 BYTES
0320:A2 03     54          LDX  #3       : COUNTER
0322:BD 4B 03   55 LOOP2    LDA  DATA0,X  : GET NEXT DATA0
0325:8D 90 C0   56          STA  POUT     : SEND TO PRINTER
0328:20 43 03   57          JSR  SENSE    : WAIT TILL PRINTER DONE
032B:CA       58          DEX
032C:10 F4     59          BPL  LOOP2     : IF NOT DONE

```

*Listing 1 continued on page 254*



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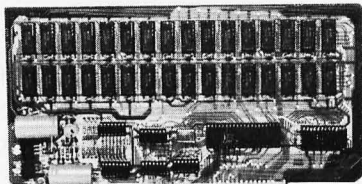
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four	thirty	cent	error	kilo	on	space	f	w
five	forty	400hertz	tone	feet	left	out	speed	g
six	fifty	800hertz	tone	flow	less	over	star	h
seven	sixty	20ms	silence	fuel	lesser	parenthesis	start	i
eight	seventy	40ms	silence	gallon	limit	percent	stop	j
nine	eighty	80ms	silence	go	low	please	than	k
ten	ninety	160ms	silence	gram	lower	plus	the	l
eleven	hundred	320ms	silence	great	mark	point	time	m
thirteen	thousand	can't	million	greater	meter	pounds	try	o
fourteen	zero	comma	high	milli	rate	volt	p	q
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blue	east	going	north	repeat	turn
brake	"ed"	green	not	replace	under
button	emergency	hale	notice	room	use
buy	enter	heat	open	safe	waiting
called	entry	hello	operator	second	warning
caution	"er"	help	or	secure	was
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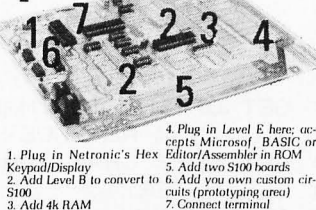
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```

032E:      60 *
032E:      61 * NOW OUTPUT CHARACTER DATA
032E:      62 *
032E:68      63          PLA          : GET OFFSET TO CHAR.
032F:AA      64          TAX          : PUT IN X AS INDEX
0330:BD 4F 03 65 LOOP3    LDA  DATA1,X : GET NEXT CHAR. DATA
0333:C9 00      66          CMP  #0      : DELIMITER?
0335:F0 09      67          BEQ  EXIT      : IF DONE
0337:8D 90 C0    68          STA  POUT      : SEND TO PRINTER
033A:20 43 03    69          JSR  SENSE      : WAIT TILL PRINTER DONE
033D:E8          70          INX          :
033E:10 F0      71          BPL  LOOP3      : IF NOT DONE
0340:      72 *
0340:      73 * ALL DONE SO EXIT VIA RESTORE ROUTINE
0340:      74 *
0340:4C 3F FF    75 EXIT      JMP  RESTORE
0343:      76 *
0343:      77 *****
0343:      78 * SUB ROUTINE TO SENSE THAT PRINTER HAS
0343:      79 * FINISHED PRINTING LAST CHARACTER.
0343:      80 *****
0343:      81 *
0343:AD C1 C1      82 SENSE    LDA  PSENSE      : GET PRINTER STATUS
0346:C9 FE      83          CMP  ##FE      : STILL BUSY ?
0348:F0 F9      84          BEQ  SENSE      : IF YES
034A:60          85          RTS          : IF PRINTER READY
034B:      86 *
034B:      87 *
034B:      88 *****
034B:      89 * DATA GROUPS
034B:      90 *
034B:00 06 4B      91 DATA0    DFB  0,6,$4B,$1B : CONT.K,6 IN REV.ORDER
034E:1B
034F:      92 *
034F:18 25 25      93 DATA1    DFB  $18,$25,$25,$25,$5A,0 :G DATA
0352:25 5A 00
0355:02 01 21      94          DFB  2,1,$21,$BE,$20,0 : J DATA
0358:BE 20 00
035B:3F 24 24      95          DFB  $3F,$24,$24,$24,$18,0 : P DATA
035E:24 18 00
0361:18 24 24      96          DFB  $18,$24,$24,$24,$3F,0 : Q DATA
0364:24 3F 00
0367:39 05 05      97          DFB  $39,5,5,5,$3E,0 : Y DATA
036A:05 3E 00
036D:      98 *
036D:00      99 SUM        DFB  0          :SCRATCH DATA
036E:      100 *
036E:E7 EA F0     101 MATCH    DFB  $E7,$EA,$F0,$F1,$F9 :G, J, P, Q, Y
0371:F1 F9
0373:      102 *
0373:      103 * END OF SOURCE
0373:      104 *****
0373:      105 * TEST ABOVE ROUTINE
0373:      106 *****
0373:A9 54      107 TEST    LDA  #54          : 'T'
0375:20 02 C1      108          JSR  PRINTER
0378:A9 F9      109          LDA  #F9          : LOWER CASE "Y"
037A:20 00 03     110          JSR  ENTER
037D:A9 0A      111          LDA  #A          : LINEFEED
037F:4C 02 C1     112          JMP  PRINTER      : EXIT VIA PRINTER
0382:      113 *****

```

\*\*\* SUCCESSFUL ASSEMBLY: NO ERRORS



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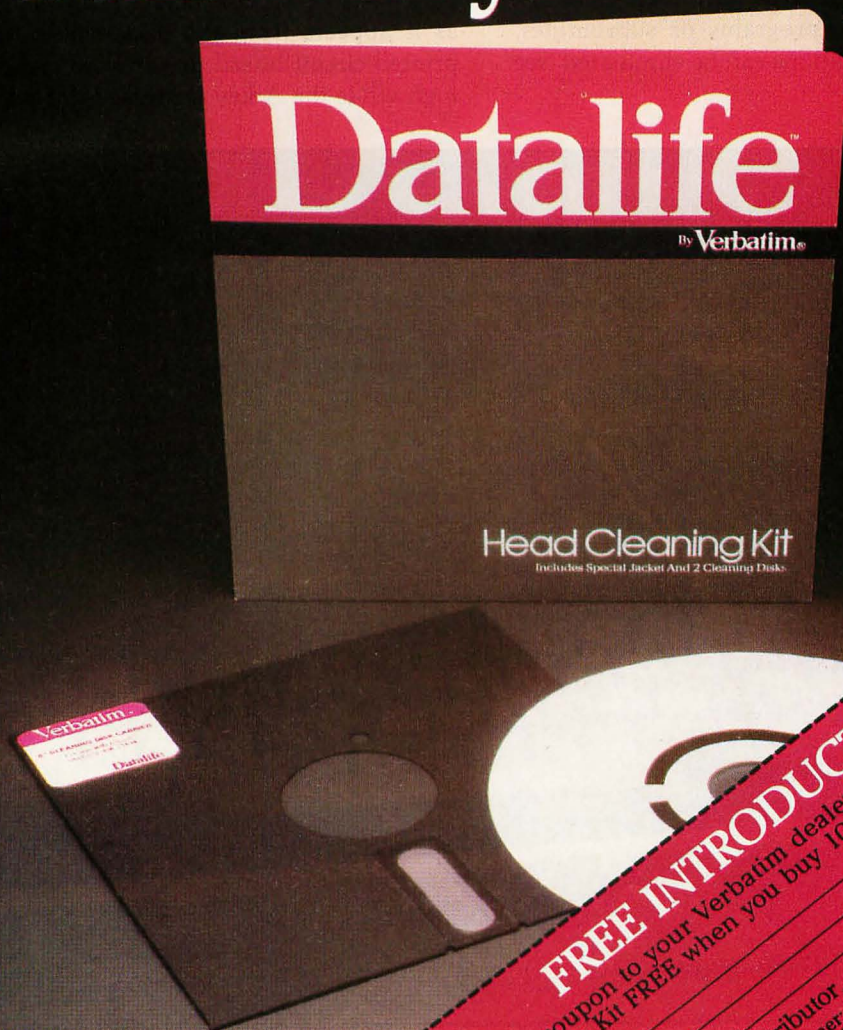
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# Add a Full-Sized Keyboard to Sinclair's ZX80

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Wayne J. Cosshall  
Swinburne Institute of Technology  
POB 218  
Hawthorne 3122  
Swinburne, Australia

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The Sinclair ZX80 keyboard has several obvious limitations. After only a short period of use, the user will begin to realize that the keyboard is awkward and doesn't really allow any degree of speed. Another limitation is not so obvious: the lack of a true reset button. This may not be apparent when running BASIC programs, as the break key works well, but a reset button is necessary when running machine-code programs or subroutines. Thankfully, all of these limitations can be eliminated (see photo 1).

### Adding the Keyboard

The ZX80 decodes its keyboard by software. To the processor, the keyboard appears as a block of I/O (input/output) ports. The upper 8 bits of the address bus, A8 through A15, are apparently used to strobe the keyboard sequentially, and the resulting values on the data bus are decoded. Figure 1 shows this interconnection as it appears from the back (solder side) of the ZX80 printed-circuit board. If software makes address line A9 high while the A key is pressed, D1 will be high, but D0



Photo 1: The ZX80 in operation with its new keyboard.



# AH-HA!



# EUREKA!

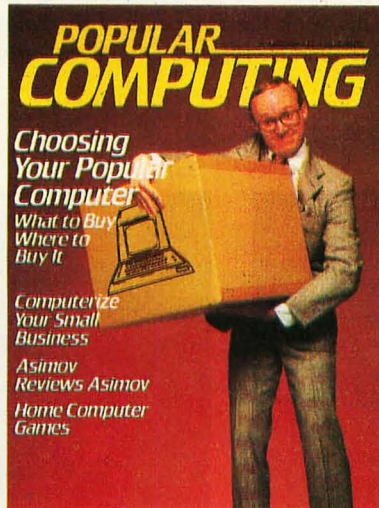
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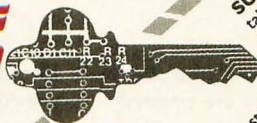
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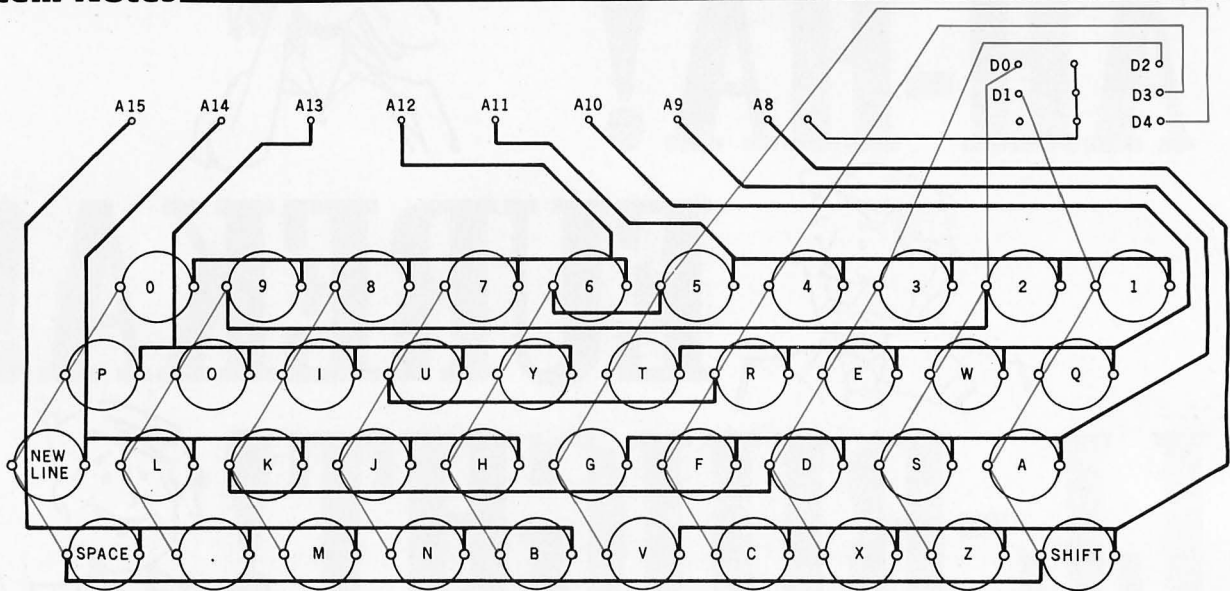
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## System Notes

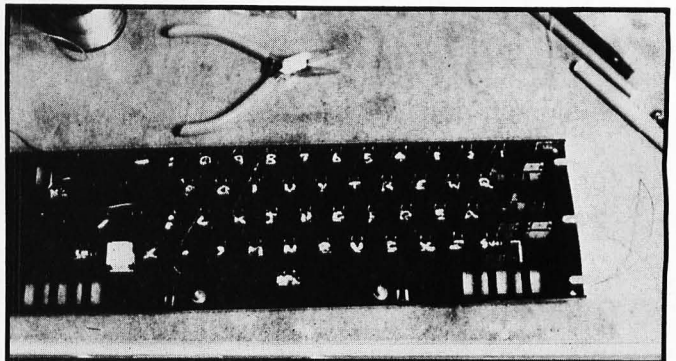


**Figure 1:** The connection of keys on the Sinclair ZX80 keyboard. The black lines represent actual traces on the "solder side" of the printed-circuit board. The red lines are connections made on the other side of the board. The ribbon-cable connection to the new keyboard is made to the points labeled A8 through A15 and D0 through D4. When wiring the new keyboard, all connections should follow this diagram.

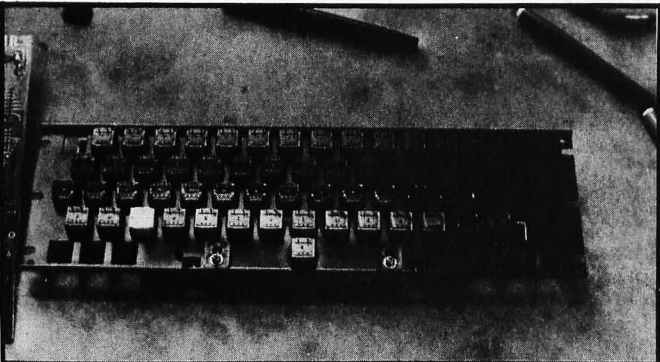
(2a)



(3a)



(2b)



(3b)



**Photo 2:** The standard-sized keyboard shown in photo 2a is made of a metal plate into which the keyswitches are pressed. Photo 2b shows the solder lugs to which connections will be made.

**Photos 3a and 3b:** Wiring the new keyboard. Photo 3a shows the first set of installed jumpers. The wire is standard 30 AWG wrapping type, wrapped once around each post before soldering. Photo 3b shows the completed jumper system.



and D2 through D4 remain low.

Photo 2a shows the keyboard I used, consisting of a metal base with holes into which the keyswitches are pushed. Two solder lugs on the back of each keyswitch make the connections (see photo 2b). Many of the symbols that are unshifted on a normal keyboard are obtained by using the shift key on the ZX80; consequently a number of keys on the new keyboard will not be used.

The first step is to wire the keys together (use figure 1 as a guide). Keys do not have to be arranged as they are on the ZX80, as long as the connections remain the same, and two or more keys may be used for the same function by wiring them in parallel (i.e., wire one as shown, then wire the two posts of the second key to the corresponding posts on this first key—I did this with the shift key to use the second shift key on the keyboard). Photo 3 shows how to wire the keys together. I used striped Kynar (wire-wrap) wire to make the connections and insulating tape to shield the wires where necessary. A connector may be added to the free end of the ribbon cable.

The second step involves the connection at the ZX80 end. The ribbon cable should be carefully soldered to the points shown in photos 4a through 4c, then extra solder added to obtain a good connection. Avoid applying too

much heat as it can damage the board or solder pads. Again, a connector can be added to the ribbon cable.

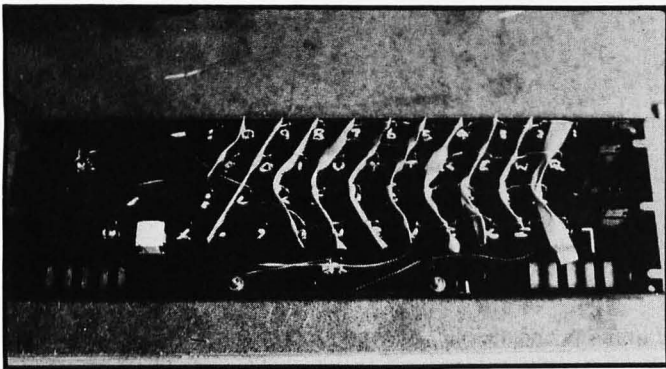
Once the final connection is made, you're ready to test the keyboard. If you have problems, recheck your wiring on the new keyboard for a short circuit or broken connection. I had no such problems—the keyboard worked perfectly from the start. One potential problem, key bounce, never arose. Apparently the touch-sensitive keys on the ZX80 aren't as prone to this phenomenon as other keyboards. A constant worry was that the technique the ZX80 used to handle key bounce would not allow sufficient time for the key bounce on the new keyboard to settle down. In practice, however, this was not a problem.

### Adding the Reset Key

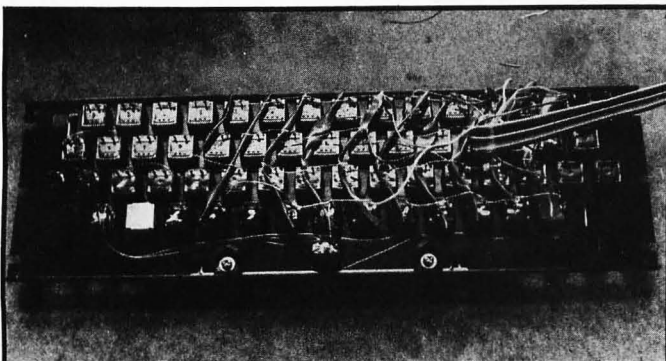
To reset, simply connect the reset pin of the Z80A processor, pin 26, to ground. There are two ways of doing this. The first uses the expansion bus. Pin 21A on the component side is the reset line, and pins 4B and 5B on the solder side are ground. All that is required is to connect a momentary contact switch between these two pins.

The second technique involves making these connections closer to the processor. I chose this approach because connections had already been made on the

(3c)

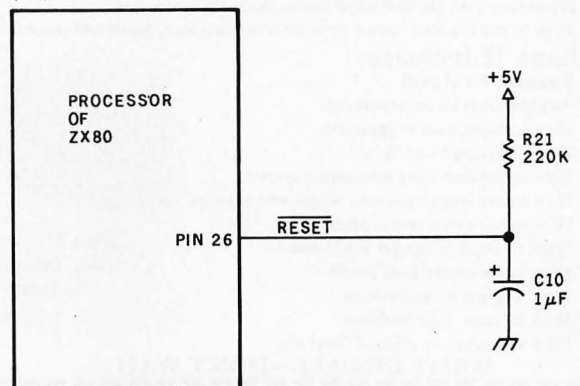


(3d)



Photos 3c and 3d: Extra insulation is added in photo 3c, and photo 3d shows the installed ribbon cable.

(2a)



(2b)

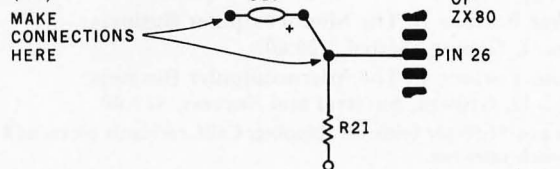


Figure 2: Diagram of the reset system used in the ZX80. Figure 2a is a schematic representation of the reset circuitry. Figure 2b is a sketch of the solder side of the circuit board where the connection to the reset key is made.



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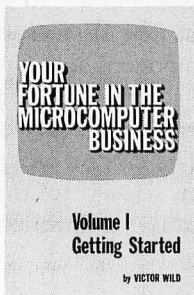
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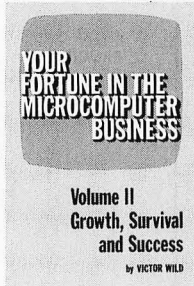
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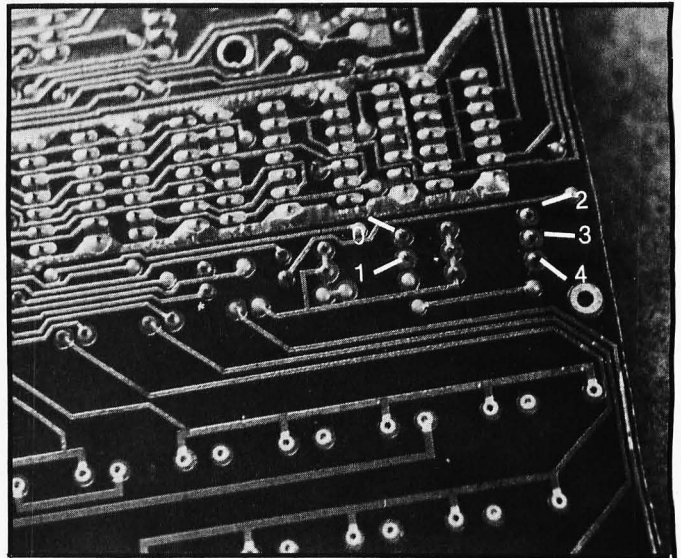
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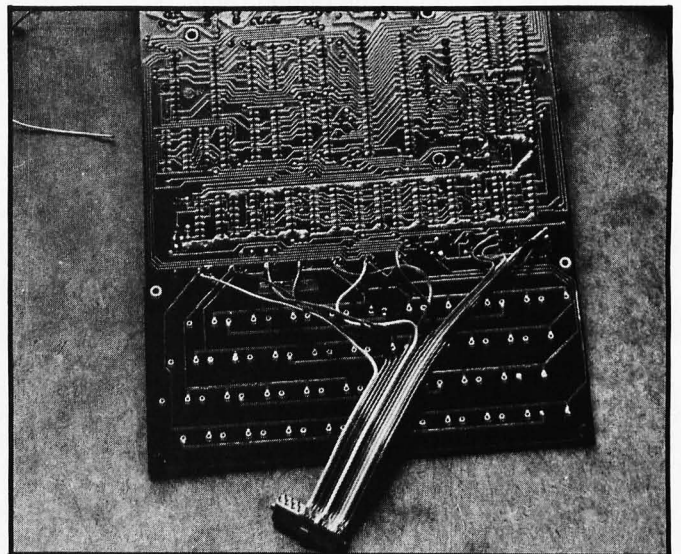
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## System Notes

(4a)



(4b)



Photos 4a and 4b: Ribbon-cable connections to the ZX80. Photo 4a shows the solder pads to which the data-bus connections should be made (labeled 0 through 4). Photo 4b is the completed ribbon-cable connection.

underside of the board for the keyboard, so two more didn't matter.

Pull-up resistor R21 and capacitor C10 on the ZX80 are connected to the reset pin of the processor (see figure 2a). Thus, the reset switch can be connected between pin 26 of the processor and the grounded side of the capacitor (see figure 2b). I ran two lines with the ribbon cable to the keyboard I had added and connected *two* spare keys in series such that both have to be pressed together for a reset. This minimizes the chance of an accidental reset.

These simple modifications greatly increased the accuracy, speed, and ease of use of the Sinclair ZX80, and neither process is beyond the ability of anyone who has used a soldering iron on printed-circuit boards. ■



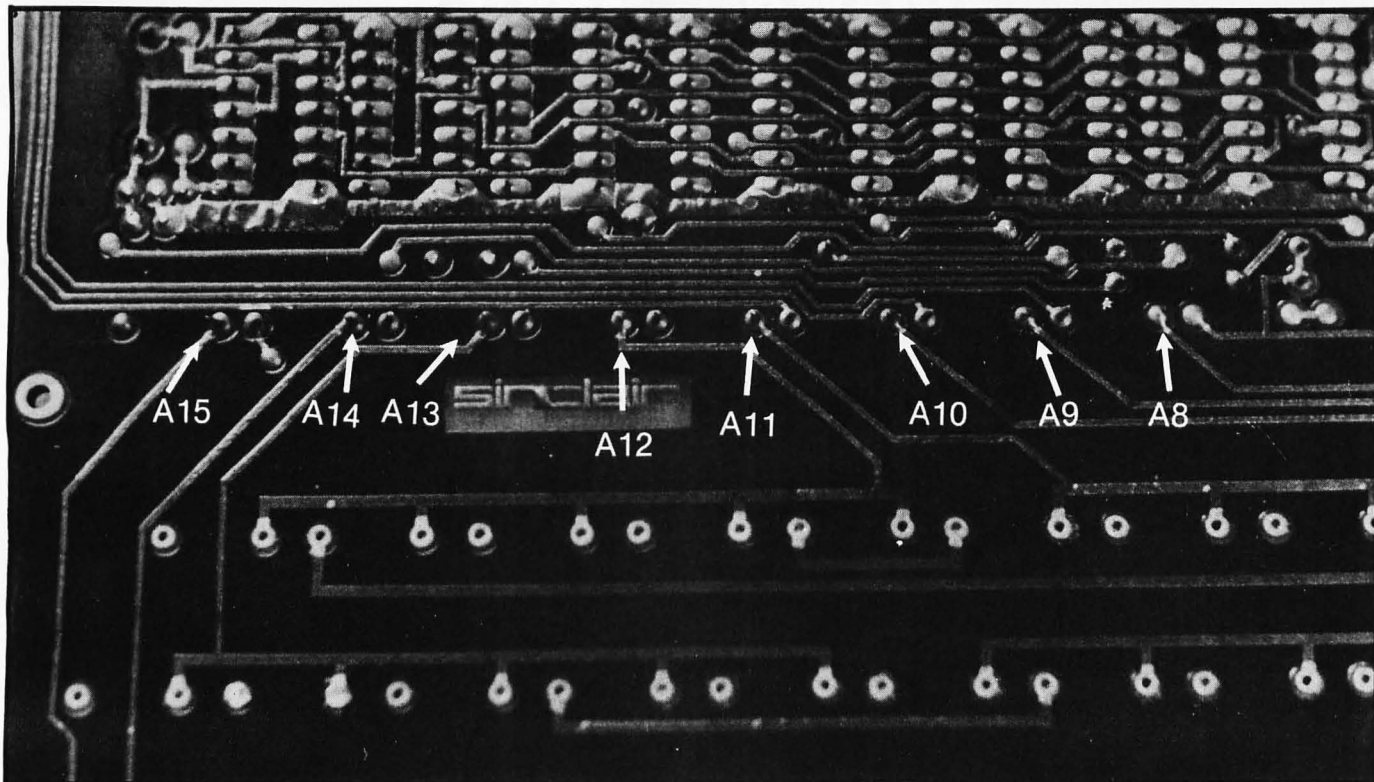


Photo 4c: The pads to which the address lines should be connected.

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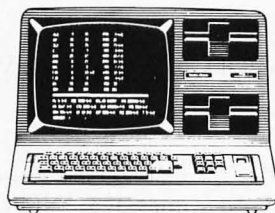
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## Text Editing with Compuview's VEDIT

---

H. Bradford Thompson  
Department of Chemistry  
University of Toledo  
Toledo, OH 43606

---

VEDIT is a fast, friendly, adaptable, full-screen editor for use with CP/M and compatible operating systems. It is the first software product from Compuview, based in Ann Arbor, Michigan. If you're writing programs on the editor that came with CP/M, and particularly if you've never used a full-screen editor, then what follows will probably be of interest to you. With VEDIT, you always have a full screen of text in front of you. To add or change, you just type. If this review gives you an appetite for simplicity while editing, then VEDIT, at \$130, is well worth considering.

If you already own a word processor or a full-screen editor, you might still be interested in VEDIT. It's very adaptable to your video-display terminal, to your preferences in assigning special keys, and to the task at hand. I keep three versions: one for general text writing, one for BASIC programming, and one for assembler programming. (More about this under Customization.) VEDIT performs best as a programmer's editor. You can write notes, letters, and even manuscripts on it, but VEDIT is not a word processor.

### What It's Like to Use VEDIT

VEDIT has two operating modes: a command mode (which works like a conventional command editor) and a visual mode. In visual mode, the screen is filled with a portion of the text. Most work is done in visual mode, so I'll describe that first.

The portion of text on the screen is called the *window*. I began the final version of this article by giving CP/M the command:

VEDIT BYTVEDIT.REV

If the file BYTVEDIT.REV had not existed, the message NEW FILE would have appeared briefly, after which the screen would have been cleared, with the cursor at upper left ready for entry of text. Until you have a change or correction to make, you just type in your text. In this case, the file already existed, so the window filled with the first lines of the file, with the cursor at upper left. You can move the cursor over the window at will, adding, changing, or inserting text. If the cursor rests on

existing text, what you type normally overwrites the old text. With one key, however, you can switch to an insert

### At a Glance

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VEDIT

**Type**  
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**Manufacturer**  
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618 Louise  
Ann Arbor, MI 48103  
(313) 996-1299

**Price**  
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**Format**  
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**System needed**  
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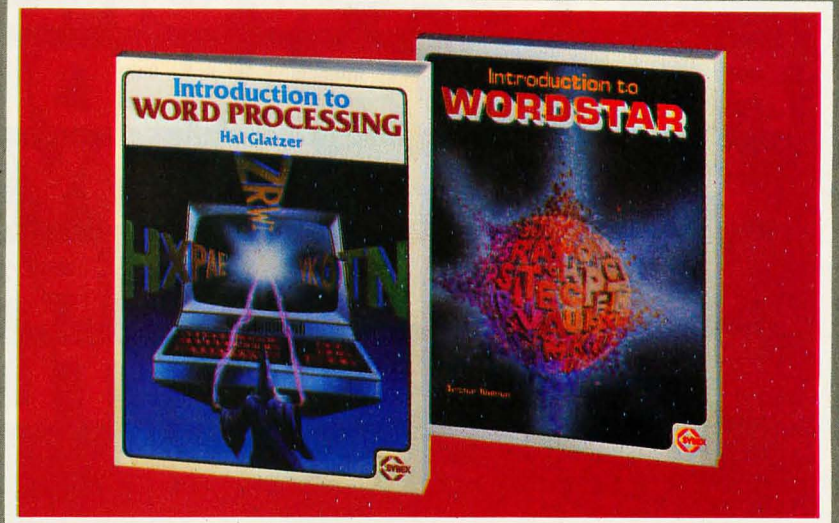
**Documentation**  
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**Audience**  
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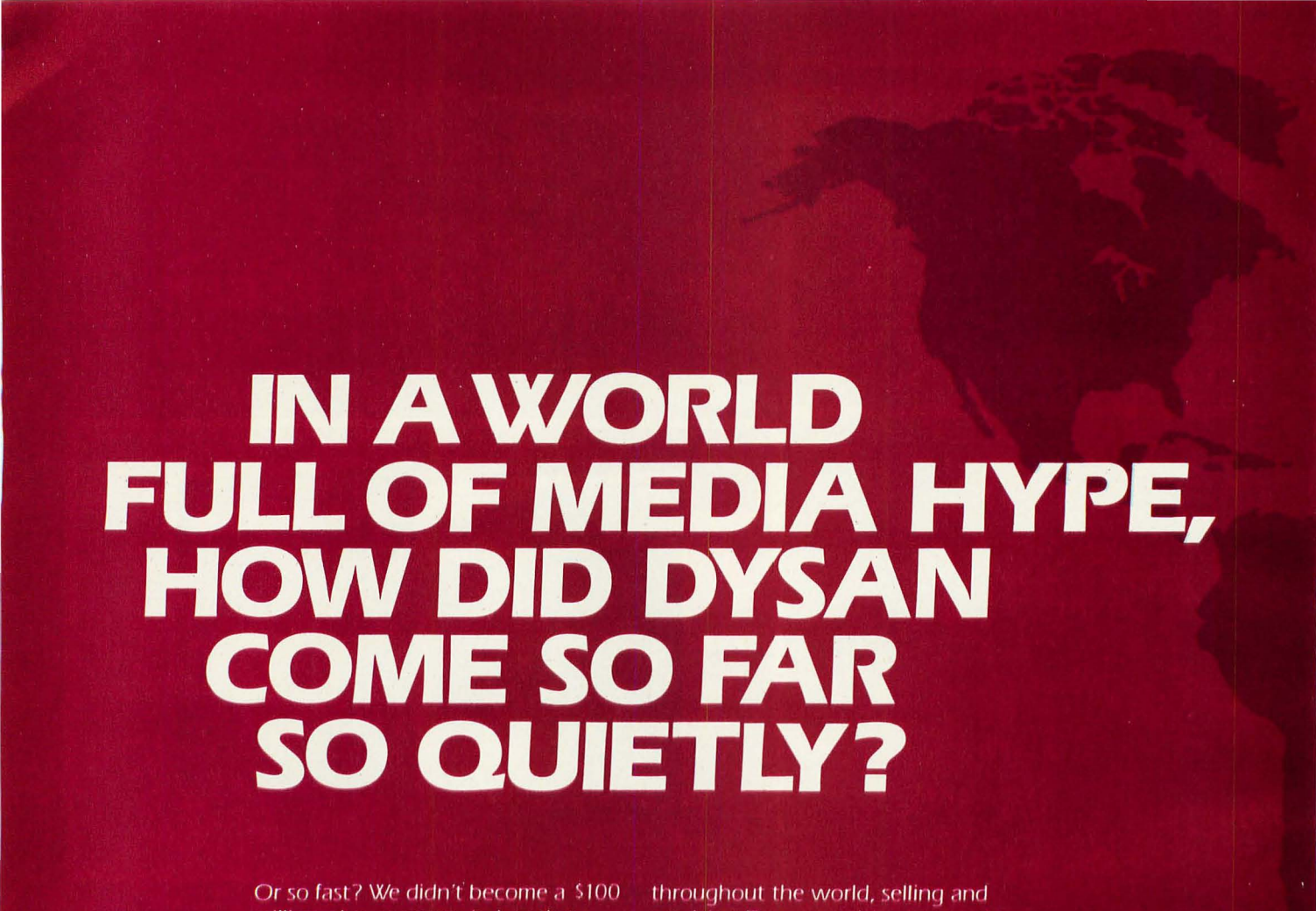
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mode, where the new text is inserted and everything to the right is shifted to make room.

Old text can be deleted by typing spaces over it (which leaves blanks), by backspacing (which moves the cursor left, deletes that character, and closes up the line), or by hitting Delete (which does the same without moving the cursor). In addition to the usual moves up, down, left, and right, VEDIT's cursor commands include single-key moves to the start or end of the current line, to the beginning of the next line, or to the next tab stop.

Once you've mastered on-screen maneuvers, how do you move the window? VEDIT has one-key instructions that page up or down a little less than one screen-height; others move the window and cursor to the beginning or end of the text. If you want to move up or down just a few lines, move the cursor up until it reaches the third line (or fourth or fifth, the value is set during customization). From that point on, additional Up Cursor keystrokes move the text

down through the window (unless, of course, you're already at the beginning). Moving the cursor close to the bottom also scrolls the text up through the window.

An editor should be able to perform functions in addition to these on-screen manipulations. VEDIT handles these via an adequate command mode, which is designed to work nicely in tandem with the visual mode. For example, to replace every occurrence of the word OLD with the word NEW, the command string is:

```
#<S OLD $ NEW $> $$
```

The # means "do the contents of < > as often as necessary." S is the substitute command, and \$ is echoed when the escape key is used. By adding a V command,

```
#<S OLD $ NEW $V> $$
```

VEDIT enters the visual mode after each substitution, with the cursor marking the point where the change was made. If the substitution is sat-

isfactory, you press one key to return to command mode. Since the V command is inside the < >, you're immediately back in visual mode, with the cursor marking the next substitution. Of course, you may discover that you set up the substitute command incorrectly. VEDIT's author has provided another escape from visual to command mode, which jumps out of the < >.

Command mode has an adequate set of editing commands, considering you'll spend most of your time in visual mode. It also provides file-handling commands and a means for changing disks and escaping from write-error and full-disk situations. I made up a full disk for testing and VEDIT did indeed let me off the hook in two ways: by deleting a file to make space or by changing disks.

## Customizing VEDIT

For those of us tinkering with new systems, VEDIT's strongest point may be its adaptability. The process is versatile, simple, and well documented.

VEDIT comes in versions for 8080 or Z80 processors and for serial interface or memory-mapped video displays. I've tested only the Z80, video-display version. You set up VEDIT by running a customization program called VEDSET, which leads you stepwise through the required choices. VEDSET first presents a list of nineteen popular terminals, including the Lear-Siegler ADM-3A, Heath H-19/Z-19, DEC VT52, Hazeltine, and Televideo, from which you identify your own. This lets VEDSET install the display-control escape sequences unique to your terminal, unleashing the speed made possible by those expensive features. If your terminal isn't included or if you've built your own, VEDSET provides special instructions and even an assembly listing of the terminal-dependent routines and tables.

I've done most of my testing of VEDIT on a North Star Horizon with 51K bytes of memory, two disk drives, and a Zenith Z-19 (alias Heath H-19) terminal. I've also used a Cambridge Development Labs Graphics Display plus a homebrew character

TO START OF BUFFER	PAGE UP	
Switch insert mode	Cursor up	Undent
TO START OF THIS LINE	NEXT TAB	TO END OF THIS LINE
Cursor left		Cursor right
TO START OF NEXT LINE	PAGE DOWN	TO END OF BUFFER
Indent	Cursor down	
COPY TO TEXT REGISTER	MOVE TO TEXT REGISTER	INSERT TEXT REGISTER

**Figure 1:** Suggested keypad layout for Heath H-19 terminal. Shading (shifted keys) indicates large cursor movement and accompanying window movement as required. The H-19 should be set to Heath mode, the keypad shifted using internal switches and also set to Alternate keypad mode by including the sequence ESC = in the terminal initiation routine in the BIOS section of CP/M.



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generator and terminal emulator, which provided a pretty rigorous test of those special instructions. VEDIT makes good use of smart terminal features when they're available. However, unforeseen questions may arise. For example, H-19 users should be aware that VEDSET assumes your H-19 is in "Heath Mode." If you've set the internal switch to "ANSI Mode," you'll want to set it back. It didn't take me long to work this out, but Compuview's literature, including the special sheet on the H-19, failed to mention it. Other terminals may have similar problems.

The Compuview people urge you to contact them if you have trouble, and my experience indicates that they mean it. A phone call (on a different question) yielded technical assistance right away, and when things became complicated, I was connected with VEDIT's author, Ted Green.

The next step in customization is assignment of keys for cursor and window movements and for a dozen other special operations in visual mode. If your terminal has special function keys, you can assign them. You can also use any control character (except CTRL-M) or ESC followed

by any letter. The assignment process is simple: VEDSET names the function, and you strike the key(s) you want to use. VEDSET will reject unsuitable choices. A sample layout for a keyboard without special keys is provided. My package included a suggested layout for the H-19, but I devised one I like better; its third revision is shown in figure 1. The instructions encourage you to try one of the sample setups and then revise it to suit yourself.

In the final segment of customization, you enter your screen size in characters, the number of lines up and down that you want the window to move when paging, and similar parameters. You can also set up two features of special convenience to programmers. First, there's a selective lowercase-to-uppercase conversion that operates on each line of text until some particular character is encountered. This lets you leave the caps lock off when entering programs, type your code in all caps, and type your comments in lowercase. VEDIT switches modes when it crosses the ; (semicolon) in 8080/Z80 code, the ' (apostrophe) in Microsoft BASIC, or the ! (exclamation point) in DEC BASIC Plus. This feature can be set up during customization and then altered during use from command level.

Second, there's Indent/Undent. You define a special key for Indent and another for Undent during setup and also specify an indent increment (say, 5 spaces). Each time you press the Indent key, it changes the position the cursor goes to when you press Return. One Indent and you return to position 6 instead of position 1; press Indent again and you now return to space 11, and so on. Each tap of the Undent key undoes one Indent. Even if the language you're writing doesn't require specific indents, this makes it easy to improve the readability of your code.

### Other Special Features

A feature highly touted in VEDIT publicity is the Undo key. Whatever you've done on the line you're editing, one stroke on Undo and the whole line is restored—you're back

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where you started. That seems like a good thing, but I don't use it much.

VEDIT also has a *text register* for moving or copying a block of text. Place the cursor at the beginning of the block, hit the Move key, move the cursor to the end of the block, and hit Move again. The block, now placed in the text register, disappears from the screen. You then move the cursor to wherever you want the text and hit the Insert key. Copy works the same way but doesn't delete the copied text from its original location. The Move key can also be used to delete a block of text.

One of VEDIT's best features is its speed in visual mode. VEDIT rarely rewrites the screen when it isn't necessary, and even when it does, the time required is not excessive. On the Z-19 at 9600 bps (bits per second), most operations seem instantaneous. Command mode, however, is another matter. A loop I set up to remove the first six characters from each line of a 200-line file took about 30 seconds.

### VEDIT and Large Files

On my 51K-byte system, VEDIT's text buffer holds 35,786 bytes. (For comparison, Microsoft's EDIT80 holds 32,974, and Digital Research's ED holds 28,589.) That's almost 900 40-character lines. I rarely write single program modules that long, so I have limited experience with VEDIT's disk buffering for large files. On a 32K byte system, the buffer would hold about 17K bytes or over 400 lines.

Like most simple editors, VEDIT processes long texts by reading lines from an input file into the text buffer, where editing can take place, then writing into an output file. Progress is one-way. You can move the window at will over the text in the buffer, but once lines have been written to the output file, the entire text must pass through before the beginning can be reread.

VEDIT has command mode instructions to open and close files, to read and write lines, and to switch logged-in disks. There's even a single command to process the entire text and restart at the top of the file. However, these instructions aren't

needed in the simplest cases. VEDIT does auto-buffering while in visual mode: if you page past the end of the buffer contents, the first lines are written to output and new lines are read from the input file. Normally, the buffer is no more than 80 percent full, leaving lots of room for insertions. VEDIT also writes to the output file if you fill the buffer by insertions.

My experience with other editors proved that supposedly legal operations could hopelessly scramble files on my disks. I've tried all the combinations that usually cause trouble,

but VEDIT seems to handle them flawlessly.

### What VEDIT Doesn't Do

I haven't found any serious bugs in VEDIT. A minor problem arises when you use the terminal's Repeat button to move the cursor around quickly or to delete a long string of characters. This works until VEDIT is required to do more than a simple operation. For instance, a repeated Up Cursor works until the cursor reaches the line where VEDIT must scroll down and write a new top line for each incoming Up Cursor. If Up Cur-

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sor consists of the sequence ESC A, the Escapes can get lost, and one or several As may appear in your text. VEDIT's author, Ted Green, tells me that this problem is at its worst on the Heath H-19 terminal—the Repeat just sends too fast. In the absence of an interrupt-driven input buffer routine, the only remedy is a light touch on the Repeat button.

You can't enter control characters or reverse-video text into VEDIT's text buffer while in visual mode, presumably because any control character is a potential special function key. You can, however, switch to command mode, insert, say, your CTRL-L form feed, switch back to visual mode, and there it is, represented by the usual ^L.

Unfortunately, VEDIT doesn't provide a means for sending text to a printer. The only way you can print current text is to exit and use some other program. I find this annoying, but it hasn't caused me to take my command editors out of retirement.

## Conclusions

VEDIT is a convenient, friendly, full-screen editor available at a reasonable price. It has several features specifically designed for program preparation and, for that purpose, has distinct advantages over command editors. It's readily adaptable to a wide variety of terminals and takes advantage of smart-terminal features. Special function keys can be assigned whatever functions you wish. If you don't have special function keys, substitute control characters and escape sequences of your own choice. The well-documented customization process is easily accomplished.

In addition to its screen mode, VEDIT has an adequate command mode. The command mode is useful in setting up string searches and substitutions; it also allows iteration macro commands that include transfers into visual mode and back. You won't spend much time in command mode. As part of a word-processing system, VEDIT has several limitations. You can't underline or even insert control characters in visual mode, and you can't send text to a printer. ■



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## Add a Cassette Interface to Your VIC-20

---

William R. Hale  
3309 June St. NE  
Albuquerque, NM 87111

---

During the time I've owned a Commodore VIC-20, I've found it to be an excellent home computer. You really get a lot for your money. With so many excellent peripherals being introduced recently, the VIC-20 will be a great addition to the home computer market. I do feel, however, that the price (almost \$100) Commodore is asking for a cassette recorder is a little high. Thus, I decided to design my own interface.

Figure 1 (on page 274) is a schematic of an interface that allows use of an ordinary, portable audio-cassette recorder to store programs from a VIC-20. The cost of the few parts needed, including a plastic case, runs about \$10; the parts are available at Radio Shack and other electronic parts stores. The audio tape needed to store programs need not be of high quality due to the tones the VIC-20 uses. The cassette "shell" itself should not be so cheap that it causes the tape to drag.

Most of the components I used were already in my home stock, including the 6-pin connector to the VIC-20 motherboard. (See figure 1 for part numbers.) The VIC-20 outputs 0 to +4 volts (V) and prefers as an input a signal of an amplitude between 0 and -4 V. (Later testing has shown that the VIC-20 will accept a 0- to +4 V input if the signal consists of true square waves and does indeed range from 0 to +4 V.) Capacitor C1 allows the recorder to receive a normal AC input; the combination of C2 and CR1 allows DC restoration for

the VIC-20 input. R2 is merely a fuse to protect the VIC-20.

L1 is an LED used to indicate that data is coming into the interface and is of sufficient level to properly operate IC1, which is being used as a wave-shaping circuit. L1 isn't a necessary part of the interface, but since the SN7404 has extra inverters, you might as well use one for the indicator. Switch S1 is also unnecessary because you can tie the line coming to it low. However, if you do this, be sure your recorder is in PLAY for the load and verify operations and in RECORD for any save operations before pressing the return key. Switch S2 is needed to rewind the tape. Always return this switch to REMOTE immediately after using it in MANUAL.

My particular recorder, Superscope Model C-76, uses +6.7 V to drive its motor, so I was able to use the VIC-20's motor-power line directly. Figure 1 also illustrates an alternate method for controlling the recorder using the VIC-20's +6.7 V motor line as a control signal.

Notice that the shield on the AUX input of the recorder is not connected to the VIC-20 system ground. I found that if I tied this line to the VIC-20 ground, noise would appear on the external speaker output of the recorder while I was attempting to load a program from the recorder. This noise was of sufficient level to trigger the input of inverter IC1 prematurely and cause an error message to be generated by the VIC-20. ■



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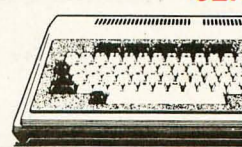
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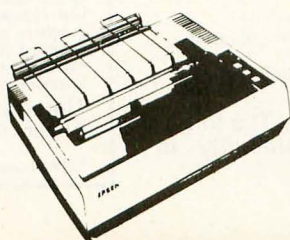
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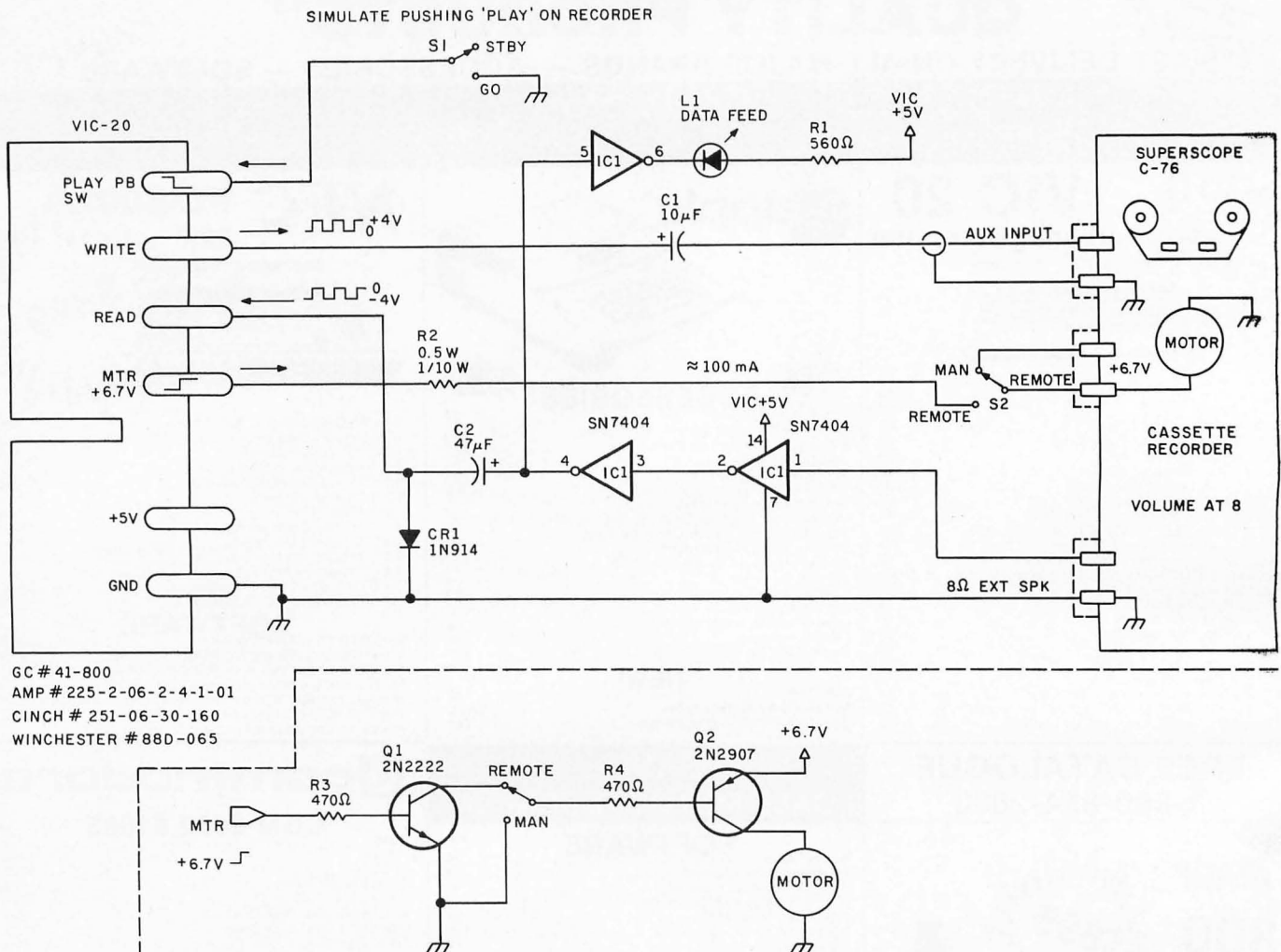
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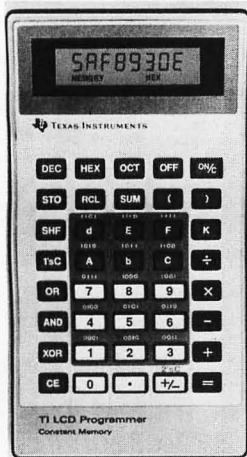
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**Figure 1:** Interface between the VIC-20 and a standard cassette recorder. Although the VIC-20 outputs 0 to +4 V, it seems to prefer a 0 to -4-V input. Switch S1 could be eliminated (see text), but it's safer to include it. Alternate sources for the connector to the VIC-20 are listed; an alternate motor control circuit is also shown.



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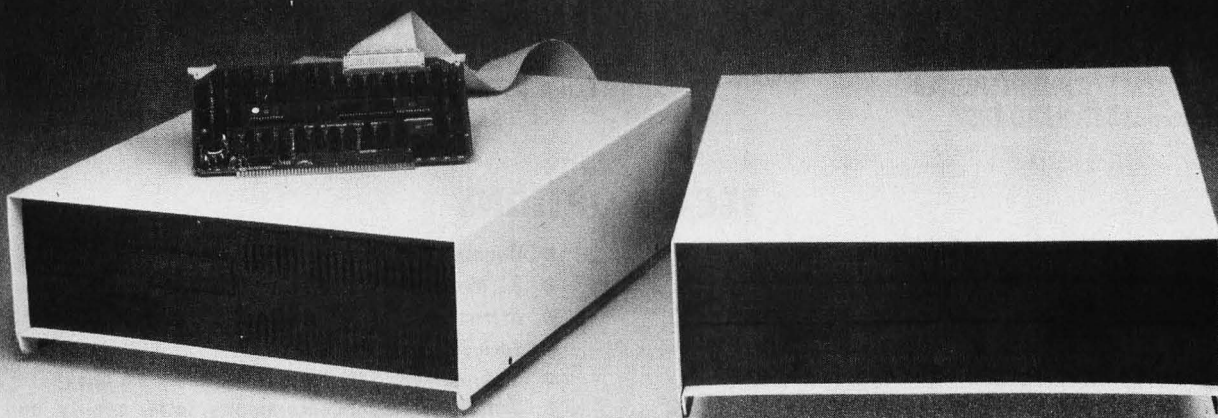
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Print Speed: 120 CPS

83A — 136 column printer w/tractor  
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Print Speed: 120 CPS

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Throughput @ 136 characters per line: 114 lines  
per minute  
Print Speed: 200 CPS

Centronics & RS-232C interfaces standard on  
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optional on all models. Centronics 8-bit parallel  
interface and Okigraph Hi-RES Graphics standard  
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Anadex-9501 W/2K buffer	\$1295.00
Diablo-630R0	\$2095.00
Citoh Starwriter 45	\$1925.00
Texas Instruments-810	\$1650.00

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Novation	d-CAT	\$ 160.00
Novation	Auto-Cat	\$ 229.00
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DC Hayes	Micro Modem II (Apple)	\$ 320.00
DC Hayes	Micro Modem 100	\$ 335.00
Lexicon	Lex-11	\$ 139.00
Livmore	LIV-Star 20M	\$ 149.00
UDS	UDS 103 LP	\$ 185.00
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Manufacturer	Model #	Price
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Amdek	100-80	\$ 169.00
Amdek	100G/12" Grn.	\$ 149.00
Amdek	Color-1 13"	\$ 375.00
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Lear Siegler	ADM-3A	Call for price
Lear Siegler	ADM-3A+	Call for price
Lear Siegler	ADM-31	Call for price
Lear Siegler	ADM-32	Call for price
Lear Siegler	ADM-42	Call for price
Televideo	TVI 910	\$ 625.00
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745-16	2/Dbi	Hard 16

Maxell	5 1/4" Diskettes	Price
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MD20	2/Dbi	Soft
MH1	1/Sgl	Hard 16
-MH20	2/Dbi	Hard 16
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FH1-32	1/Sgl	Soft 32
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# BYTE Printer Directory

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Curtis P. Feigel  
Technical Editor

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To say that the printer market has blossomed is to make an apt analogy. An immense crop of printers with exciting features has flourished in the last few years. Unfortunately, a handful of thorns is waiting for those who make a hasty grab without carefully examining the field. Only an understanding of the present state of the art and knowledge of the printers available will help the personal-computer user choose the best printer for an application.

The printer provides an important and common man-machine interface. Recent advances in printer technology allow the use of personal computers in many new ways: producing letters, checks, and even pictures. However, a printer still represents a large investment to most people—sometimes as much as the rest of the computer system. BYTE provides this list of printers and their features to help you get the necessary information.

The newest printers offer standard features that illustrate the progressive thinking of designers and manufacturers, at a low cost that would have been impossible two years ago. Through the use of dedicated microprocessors, new printers pro-

vide bidirectional printing, short-line seeking, and multiple-font capability—features that are difficult to implement with mechanical printers. The presence (or absence) of these features is the key to selection of the proper printer.

## Understanding Printers

Although a variety of printing technologies is available, the traditional *impact* printer is still the most common. The other printing concepts find favor in special applications (e.g., if copy must be produced at high speed, an ink-jet system might be used) where special attributes are used to advantage. The following is a description of the printing technologies you will discover in the microcomputer printer market:

**Impact:** Uses a type element with a raised character that strikes an inked ribbon against the paper, thus transferring the outline of the character to the paper. This is the same concept used in the common typewriter, but manufacturers have added several twists to the idea. In *daisy-wheel* or *thimble-type* printers, the complete set of type elements can be removed and replaced as a single

unit. This makes it possible to change type fonts (the style of the letters) or install characters not commonly available.

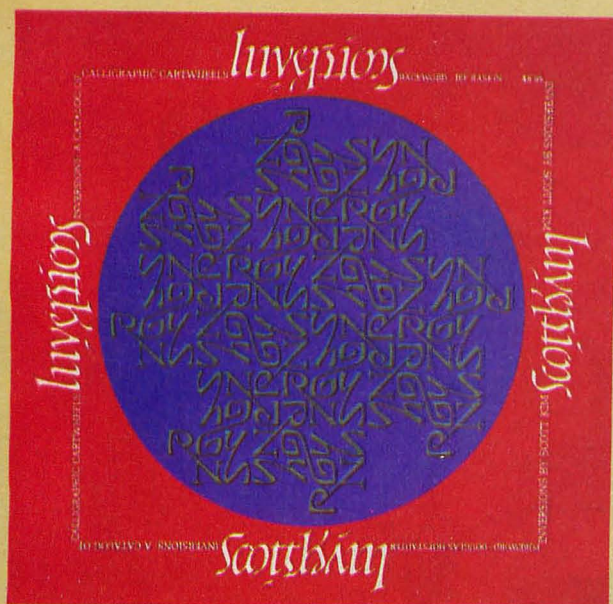
The typical small-computer owner usually opts for an impact printer that uses a *dot-matrix* type element. This device prints characters made from dots in a closely spaced grid. It is popular because of its flexibility. In many units, the characters' form is stored in memory and can be changed easily. The presence or absence of dots can be controlled by the computer (in some fashion) so that graphs and pictures can be printed.

A rather unusual printer that might be classed with impact types uses a stylus to form the characters (an idea analogous to having a machine that draws with a pencil). The theory is that this system should provide the flexibility of a dot-matrix design with the fully formed characters of a daisy-wheel-type printer.

**Thermal and Electrostatic:** Both use a form of the dot-matrix print head, but depend on special paper to create the image, rather than ink from a ribbon. These printers are usually small, allow only 20 or 40 characters on a line, and have few extra features



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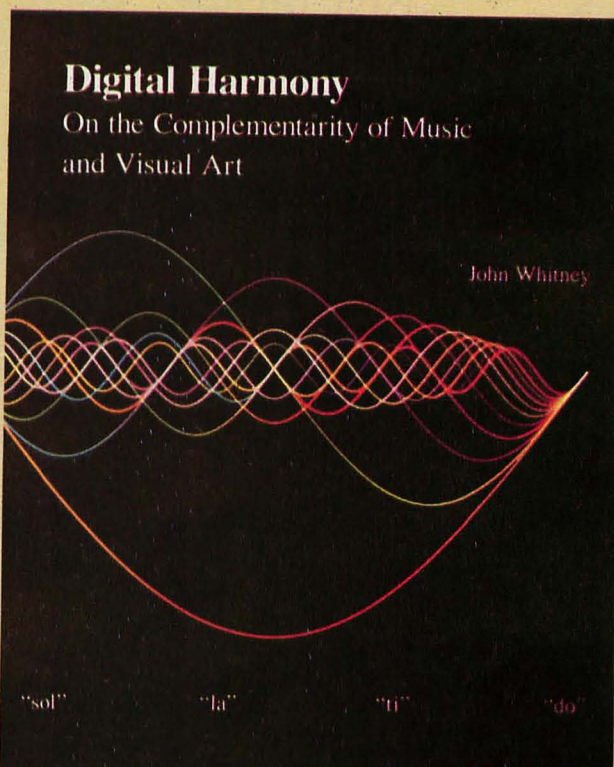
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because of their low cost. They are most popular in calculator-sized computer systems where space is at a premium.

**Ink-Jet:** This is actually a controlled spray of ink directly onto paper. Small droplets of ink formed at a nozzle are directed by electrostatic fields to cover the proper areas on the paper. This is a fast way to print whole pages because the inertia of the droplets is far smaller than that of mechanical systems. The system is flexible because the form of each character is computer-controlled.

**Laser:** Uses a raster-scan system similar in idea to a video display. The laser moves across a sensitized drum, "burning" a row of dots; as each row is completed, the beam moves down to begin the next row. The image is then transferred to paper, just as in a photocopier. Obviously, laser printers contain precision optical and mechanical parts, so they cost tens of

thousands of dollars; but they are very flexible and fast.

Because many of these systems are relatively new, manufacturers have not been able to bring down their cost. Because of this money factor, we will mainly consider the impact, electrostatic, and thermal types. Even the least expensive of today's impact printers has features that set it apart from the teletypewriter that was the common hard-copy appliance 10 years ago. Here is an explanation of the concepts behind these features:

**Print Quality:** An obvious consideration for most people and small businesses. The quality of the characters that appear on paper is mostly determined by the printer technology used. Daisy-wheel and thimble-type printers produce *fully formed* characters that look similar to those produced by typewriters or typesetting equipment. Dot-matrix printers, although usually faster, are not as a

rule capable of producing high-quality printing (the exception is multipass types that allow their dots to overlap, giving a fully formed look). In dot-matrix printers, the number of dots in the matrix is a good guide to the visual quality of the printing (i.e., a 9- by 14-dot character will probably look far better than a 5- by 7-dot one).

**Character Sets:** They can be an overriding factor if special characters are required. Although the type elements of daisy-wheel and thimble-type printers can be changed manually, many dot-matrix printers can be *programmed* with alternate character sets; some come with several preprogrammed sets. Almost all printers follow the ASCII (American Standard Code for Information Interchange) convention that assigns each standard character with a 7-bit binary number. Few printers, however, allow all 128 ASCII characters.

A related concern is the *font*, or style of type, used by the printer. This governs whether parts of the lower-case letters g, j, p, q, and y actually descend below the print line, whether the vertical lines of the characters are slanted, and whether or not the characters have serifs (short lines that extend at an angle from the ends of the main strokes of the letter). Many dot-matrix printers provide a feature to condense or expand the characters horizontally; some even slant or rotate the characters.

Although most printers produce characters that all take the same amount of space, an important feature on high-quality units is proportional spacing. (Perhaps you have noticed that typesetting—such as is used in magazines, newspapers, and books—produces characters that have a variety of widths.) This contributes much to the look of a printed page.

**Speed:** Many printers include features that allow them to print characters at a high rate. This may be as simple as a character set that is draft-quality (the printer doesn't spend much time making the character look pretty).

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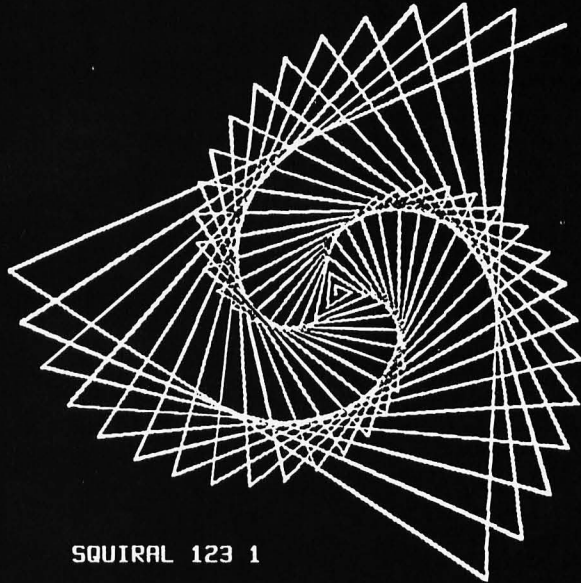
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# The Logo Language is Here for the Apple II

```
TO SQUIRAL :ANGLE :DISTANCE
  IF :DISTANCE > 200 THEN STOP
  FORWARD :DISTANCE
  RIGHT :ANGLE
  SQUIRAL :ANGLE :DISTANCE + 3
END
```



SQUIRAL 123 1

Terrapin, the Turtle Company, brings you the Terrapin Logo Language for the Apple II with Turtle graphics, now ready for immediate delivery.

The Terrapin Logo language is a sophisticated and powerful language that is easy for anyone to use. Although originally intended for children, the Logo language is one that the most advanced programmers will enjoy using too. It includes many features common to artificial intelligence research languages permitting programs of great power to be written quickly and easily. Writing comparable programs in other languages is usually much more difficult and time consuming.

The Turtle graphics is fun and easy. With simple commands such as FORWARD, RIGHT, and PENUP you can draw in six hi-res colors. In just a few short sessions you can learn to create figures more complex than the one above whether you know how to program or not.

But the Terrapin Logo language is more than just a graphics language. It supports:

- list structure, allowing easy manipulation of words (strings) and lists
- user defined procedures which can be used exactly as if they were part of the language.
- fully integrated screen editor for procedures and text
- floating point and integer arithmetic
- a total of 120 primitives (commands) including 30 graphics commands
- recursion
- assembly-language interface capability

The Terrapin Logo language was developed by the Artificial Intelligence lab at the Massachusetts Institute of Technology. Terrapin is now authorized by MIT to distribute the results of its 12 years of research to you. To provide quality support for the language, Terrapin has assembled a team that includes two of the three authors who developed the Logo language for the Apple II at MIT, as well as Dr. Feurzeig, the originator of the Logo language.

Every copy of the Terrapin Logo language comes with complete documentation. To run the language, a 48K Apple II with a 16K RAM card or a language card, and one disk drive is required.

Terrapin also offers the robot Turtle, and the following books: *Turtle Geometry*, *Special Technology for Special Children*, *Mindstorms*, *Katie & the Computer*, and *Apple Logo* from Byte Books.

Suggested retail price: \$149.95

To order or for more information, call or write:



**Terrapin, Inc.**

678 Massachusetts Avenue  
Cambridge, MA 02139  
(617) 492-8816



However, two logical concepts are important to the speed of any printer: bidirectional printing and short-line seeking. A printer that does bidirectional printing does not waste time moving the print head from the end of one line, at the right of a page, to the beginning of the next line at the left. It simply prints the next line backward, beginning at the right. A short-line-seeking printer skips over multiple spaces at a higher than normal speed and slows when the print head is located at the first printable character.

*Forms:* Paper that the printer will accept is usually limited to one or two

types. A large amount of computer printouts are done on *fanfold* paper. However, *cut sheets* are preferred for correspondence and reports. Some printers accept only roll paper, as used on adding machines. *Forms controls* that allow the printer to automatically find the top of the next fanfold page, and feeding mechanisms that load the printer with a single sheet of paper, are also available.

(Fanfold continuous paper is separated into sheets by perforations along the top and bottom of each "page." A series of holes is provided along each margin for a *tractor* to move the paper vertically through the printer. Fanfold paper is available in

a variety of styles and widths, including preprinted forms such as invoices and checks.)

Following is a listing of printer manufacturers and their products. Where possible, the information has been taken directly from the maker's literature. But please remember this caveat: a manufacturer may emphasize one feature and neglect to mention other features. Although we have made every attempt to keep the specifications accurate and up-to-date, errors do occur. Also, keep in mind that manufacturers reserve the right to alter specifications without notice.

#### A D Data Systems Inc.

200 Commerce Dr.  
Rochester, NY 14623  
(716) 334-9649

#### Addmaster Corporation

416 Junipero Serra Dr.  
San Gabriel, CA 91776  
(213) 285-1121

170: impact, 5 by 7 dot matrix; 18 or 21 char/line; 50 cps; 6 line/inch; ASCII or Baudot characters; time-of-day clock with battery backup; self test; friction feed; 2.25 inch wide roll paper; RS-232, 63 char buffer; Centronics or Apple II parallel; 8.25 by 12 by 5; 7 lbs; \$299

180: impact, 5 by 7 dot matrix (9 by 7 optional); 34 or 40 char/line; 48 cps; 6 line/inch; ASCII or Baudot characters; time-of-day clock with battery backup; self test; friction or tractor feed; 4.5 inch wide roll paper or labels; RS-232, 40 char buffer; Centronics parallel; \$399

#### Alphacom Inc.

3031 Tisch Way  
San Jose, CA 95128

*Sprinter 20:* thermal, 5 by 8 dot matrix; 20 char/line; 96 char ASCII; graphics; rotated printing; roll paper; RS-232, 110 to 9600 bps; parallel; \$175

*Sprinter 40:* thermal, 5 by 8 dot matrix; 40 char/line; 96 char ASCII; graphics; rotated printing; roll, fanfold paper; RS-232, 110 to 9600 bps; parallel; \$350

#### Alps Electric Inc.

100 North Center Ave.  
Rockville Center, NY 11570

(516) 766-3636

1200: stylus; 15, 18, 24, or 36 char/line; 6 cps; four colored ballpoint pens; graphics; all characters created under software control of the host computer; friction feed; 2.25 inch wide roll paper; 8.5 by 5.9 by 1.25; 1.1 lbs; \$450  
1100: same as 1200 except: one color only; \$325

#### Amperex Electronics Corporation

230 Duffy Ave.  
Hicksville, NY 11802

GP300: impact, 9 by 9 dot matrix; 120 or 144 char/line; 80 or 300 cps; vertical tab; paper out indicator; graphics; self test; two character sets; friction feed and tractor feed; sheet or fanfold paper; RS-232, 300 to 9600 bps; parallel; 20.5 by 17.5 by 7.4; 44 lbs; \$3165

#### Anacom General Corporation

Computer Products Division  
1116 Vallencia Dr.  
Fullerton, CA 92631  
(714) 992-0223

150: impact, 9 by 9 dot matrix; 136 char/line; 150 cps; 6 or 8 line/inch; 96 char ASCII; lowercase descenders; double-width characters; bidirectional printing; short-line seeking; self test; graphics optional; paper-out indicator; top-of-form control; tractor feed adjustable to 15 inches wide; fanfold paper; RS-232, buffer optional; parallel; 34 lbs; \$1495

150Z: impact, dot matrix; 40

or 220 char/line; 180 cps; four selectable char sets; graphics; tractor feed; fanfold paper; RS-232; parallel; \$1650

160: impact, 9 by 9 dot matrix; 80 char/line; 150 cps; 6 or 8 line/inch; 94 char ASCII; graphics; lowercase descenders; paper-out indicator; top-of-form control; tractor feed adjustable to 10 inches wide; fanfold paper; RS-232 with handshaking, 110 to 9600 bps; 256 char buffer (1K to 4K char buffer optional); parallel; 17.5 by 18.5 by 7.9; 34 lbs; \$1450

160Z: same as 160 except: 96 char ASCII, 2 pass high-quality mode; preprogrammed and programmable character sets; 70 by 70 dot graphics; self test; 4K char buffer

#### Anadex Inc.

9825 De Soto Ave.  
Chatsworth, CA 91311  
(213) 998-8010

DP8000: impact, 9 by 7 dot matrix; 80 char/line; 112 cps; 6 line/inch; 96 char ASCII; bidirectional printing; vertical tabs; double-width chars; paper-out indicator; self test; tractor feed; fanfold paper; RS-232, 110 to 9600 bps, 2 K char buffer; parallel; 18.6 by 14.2 by 7.3; 27 lbs; user-replaceable print head; \$1125

DP8000 AP: same as DP8000 except: 96 char/line; 134 cps; Apple parallel interface

DP9000: impact, 9 by 9 dot matrix; 80 char/line; 150 cps; 6 or 8 line/inch; 96 char ASCII; bidirectional printing; graphics, 72 by 60; compressed characters give 106 char/line at 200 cps; self test; tractor feed; fanfold paper; RS-232; Centronics parallel; 22 by 15.4 by 8.3; 30 lbs; \$1550

DP9001: impact, 9 by 9 dot matrix; 80 char/line; 120 cps; 96 char ASCII; compressed characters give 132 char/line at 200 cps; tractor feed; fanfold paper; RS-232; Centronics parallel; \$1550

DP9500: impact, 9 by 9 dot matrix; 80 or 132 char/line; 150 cps; 6 or 8 line/inch; 96 char ASCII; lowercase descenders; underlining; double-width characters; condensed characters; bidirectional printing; short-line seeking; graphics; top-of-form control; self test; tractor feed adjustable to 15.6 inches wide; fanfold paper; RS-232, 800 char buffer; Centronics parallel; 35 lbs; \$1650

DP9501: impact, 11 by 9 dot matrix; 80 or 132 char/line; 120 cps; 96 char ASCII; 6 or 8 line/inch; lowercase descenders; double-width characters; compressed characters give 176 char/line at 200 cps; underlining; graphics; bidirectional printing; short-line seeking; paper-out indicator; self test; tractor feed adjustable to 15.6 inches wide; fanfold paper; top-of-form control;



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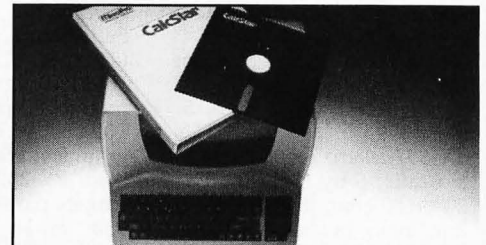
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 Cupertino, CA 95014  
 (408) 996-1010  
*Silent Type*: thermal, dot matrix; 40 char/line; friction feed; thermally sensitive paper  
**Astronautics Corporation of America**  
 POB 523  
 Milwaukee, WI 53201  
 (414) 671-5500  
**Autek Systems Corporation**  
 3200 Coronado Dr.  
 Santa Clara, CA 95051  
 (408) 496-0400  
**Axiom Corporation**  
 5932 San Fernando Rd.  
 Glendale, CA 91202  
 (213) 245-9244  
*GP-80M*: impact, 5 by 7 dot matrix formed by single hammer; 80 char/line; 30 cps; 6 line/inch; 96 char ASCII; graphics; double-width characters; tractor feed adjustable to 9.5 inches wide; fanfold paper; RS-232; parallel; 13 by 6.75 by 5; 5 lbs; \$399  
*EX-801 Micro Printer*: electrostatic, 5 by 8 dot matrix; 20 or 80 char/line; 5 line/inch; 96 char ASCII; RS-232, 50 to 1200 bps, 256 char buffer; 11.75 by 12.75 by 4.4; 12 lbs; \$599  
*EX-850 Video-Screen Printer*: impact, dot matrix; 13 seconds/page; prints any screen image formed by dots; friction feed; sheet paper; \$1595  
*IMP-1*: impact, dot matrix; 80, 96, or 132 char/line; 100 cps; 96 char ASCII; graphics, 70 by 70 dots; friction feed; sheet paper; RS-232; parallel; \$699  
*IMP-2*: impact, dot matrix; 80, 96, or 132 char/line; 100 cps; 96 char ASCII; graphics; bidirectional printing; friction and tractor feed; sheet or fanfold; RS-232; Centronics parallel, Apple II, PET, and IEEE-488 interfaces  
*IMP-4*: impact, 7 by 9 dot matrix; 80 char/line; 100 cps; 8 line/inch; 96 char ASCII; graphics, 19008 dot/inch; bidirectional printing; friction or tractor feed; sheet, fanfold, or roll paper; RS-232; Centronics parallel, Apple II, and IEEE-488 interfaces  
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 4102 148th Ave. NE

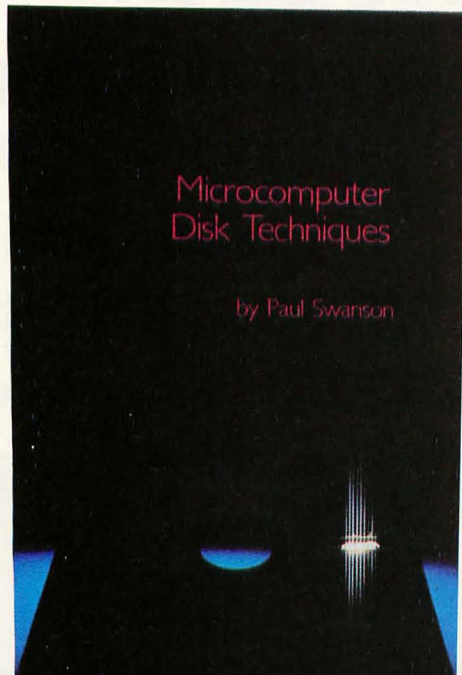
Redmond, WA 98052  
 (206) 881-5100  
*40-Column Desktop*: impact, 7 by 5 dot matrix; 40 char/line; 80 cps; 96 char ASCII; friction feed; 2.8 inch wide roll paper; RS-232, 1200 bps, 80 char buffer; 10 by 6.5 by 12.75; 11 lbs  
*40-Column Vehicle-Mounted*: same as 40-Column Desktop except: 10.5 to 15 VDC; 0.1 A (standby), 4 A (printing); 6 by 12 by 13.5; 7 lbs  
*80-Column Desktop*: impact, 9 by 9 dot matrix; 80 char/line; 57 cps; 96 char ASCII; double-width characters; bold characters; bidirectional printing; tractor feed adjustable to 10 inches wide; fanfold paper; RS-232, 9600 bps, 80 char buffer; 14.75 by 4.25 by 12; 12 lbs  
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*800MST*: impact, dot matrix; 80 or 132 char/line; 100 cps; 96 char ASCII; graphics; friction or tractor feed; RS-232, buffer; Centronics parallel  
*850*: impact, 5 by 7 dot matrix; 80 or 132 char/line; 100 cps; 6 line/inch; 96 char ASCII; short-line seeking; bidirectional printing; vertical tabs; graphics; self test; friction and tractor feed; fanfold or roll paper; RS-232, 75 to 9600 bps, 2K char buffer; Centronics parallel; 15 by 11 by 3; 15 lbs; \$799  
**BDS Computer Corporation**  
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 Menlo Park, CA 94025  
 (415) 325-2115  
**Canon USA Inc.**  
 —Components  
 10 Nevada Dr.  
 Lake Success, NY 11040  
 (516) 488-6700  
**Cardinal Scale Manufacturing Company**  
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 (417) 673-4631  
*2170*: impact, 9 by 9 dot matrix; 132 char/line; 100 cps; 96 char ASCII; draft and high-quality fonts; double-width, tall, boldface, and combination characters; bidirectional printing; short-line seeking; self test; upside-down printing; dual friction or dual tractor drives allow printer to be

loaded with two types of forms; fanfold paper; RS-232; Centronics parallel; 20 by 20 by 7; 70 lbs  
**Centronics Data Computer Corporation**  
 1 Wall St.  
 Hudson, NH 03051  
 (603) 883-0111  
*150*: impact, 7 by 9 dot matrix; 80 char/line; 150 cps; 96 char ASCII; "international" character set optional; bidirectional printing; short-line seeking; top-of-form control; friction or tractor feed; sheet, fanfold, or roll paper to 10 inches wide; Centronics parallel; 14.9 by 13.8 by 5.9; 22 lbs  
*352*: impact, 7 by 8 dot matrix; 132 char/line; 200 cps; 6 or 8 line/inch; 96 char ASCII; alternate character sets optional; bidirectional printing; short-line seeking; vertical tabs; graphics; programmable forms control; friction or tractor feed; sheet, fanfold, or roll paper; RS-232, 50 to 19200 bps, 2K char buffer; Centronics parallel; 22 by 18 by 8; 40 lbs  
*353*: same as 352 except: also has high-quality printing mode at 50 cps  
*700*: impact, dot matrix; 132 char/line; 69 cps; 64 char ASCII (96 char ASCII optional); friction and tractor feed; sheet or fanfold paper; Centronics parallel; \$1460  
*701*: impact, dot matrix; 132 char/line; 60 cps; 64 char ASCII (96 char ASCII optional); bidirectional printing; friction and tractor feed; sheet or fanfold paper; Centronics parallel; \$1700  
*702*: impact, 9 by 7 dot matrix; 132 char/line; 120 cps; 96 char ASCII; bidirectional printing; tractor feed; fanfold paper; Centronics parallel; \$2660  
*703*: same as 702 except: 180 cps; \$2965  
*704*: same as 702 except: 180 cps; RS-232; \$1795  
*730*: impact, 5 by 7 dot matrix; 80 char/line; 100 cps; 6 line/inch; 96 char ASCII; double-width characters; friction or tractor feed; sheet or fanfold paper to 9.5 inches wide; Centronics parallel; 11 lbs; \$795  
*737*: impact, line-wide by 9 dot matrix; 80 char/line; 100 cps; 6 line/inch; 96 char ASCII; lowercase descenders; underlining;

double-width characters; condensed characters; proportional spacing; reverse linefeed; friction or tractor feed; sheet or fanfold paper to 9.5 inches wide; Centronics parallel (RS-232 optional); 12 lbs; \$995  
*739*: impact, line-wide by 9 dot matrix; 80 or 132 char/line; 100 cps; 6 line/inch; 96 char ASCII; lowercase descenders; double-width characters; condensed characters; underlining; bidirectional printing; reverse linefeed; paper-out indicator; graphics; proportional spacing; self test; top-of-form control; friction feed; roll or fanfold paper to 9.5 inches wide; RS-232; 14.5 by 11 by 5; 12 lbs; \$995  
*753*: impact, line-wide by 9 dot matrix; 80 char/line; 150 cps; 6 or 8 line/inch; 96 char ASCII; bidirectional printing; short-line seeking; programmable forms control; paper-out indicator; tractor feed; fanfold paper; Centronics parallel; 24.5 by 19.5 by 8; 60 lbs  
*761*: impact, dot matrix; 132 char/line; 30 cps; 64 char ASCII (96 char ASCII optional); tractor feed; fanfold paper; RS-232, 300 bps; \$1865  
*779*: impact, dot matrix; 80 char/line; 60 cps; 64 char ASCII; friction or tractor feed; sheet or fanfold paper; Centronics parallel; \$1485  
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 Santa Clara, CA 95051  
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*4022*: impact, 5 by 8 dot matrix; 40 char/line; 30 cps; 6 line/inch; 96 char ASCII, preprogrammed alternate character set; lowercase descenders; double-width characters; bold characters; bidirectional printing; self test; top-of-form control; tractor feed; fanfold paper; IEEE-488 interface; 14.75 by 13 by 4.25; 14.6 lbs; \$795  
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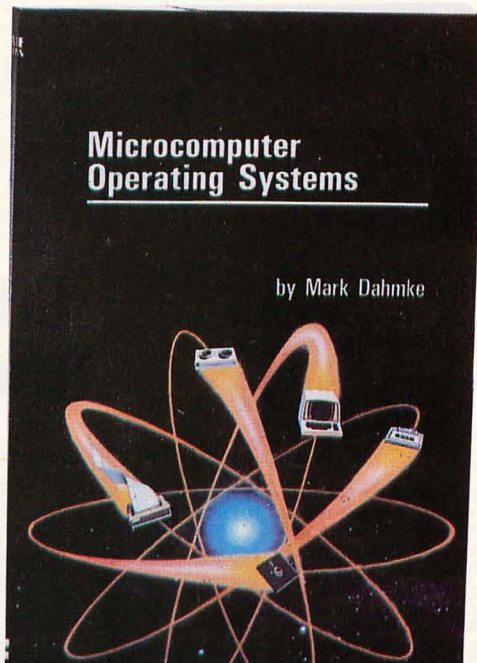
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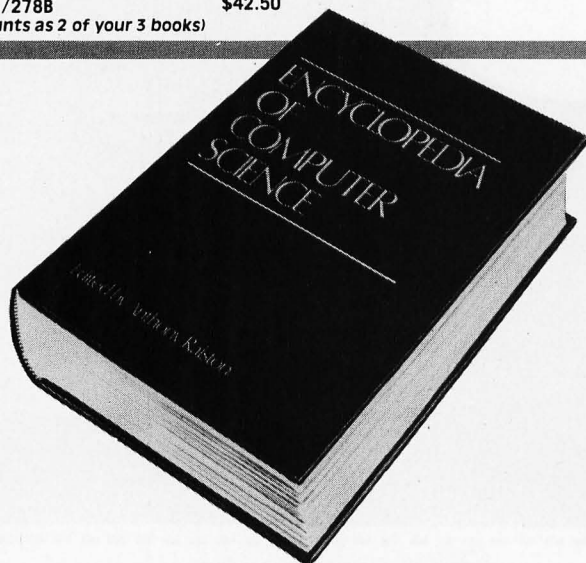
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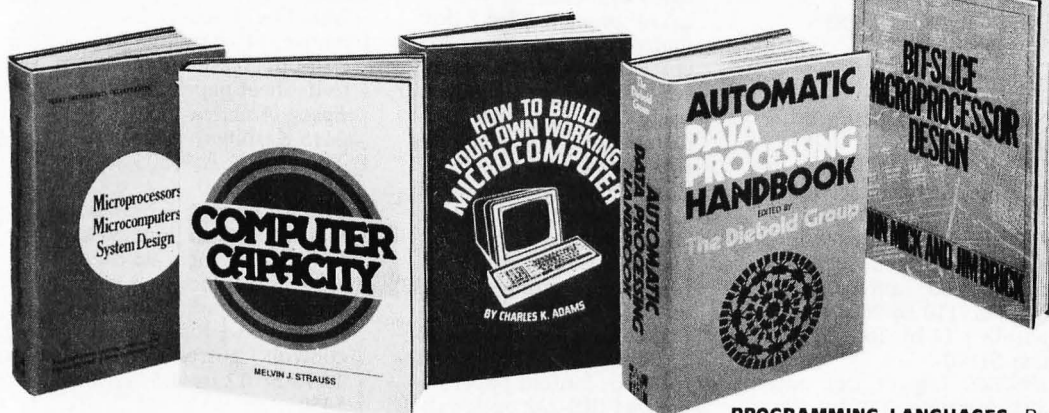
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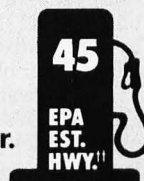
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Versatrak-60: thermal, 5 by 7 dot matrix; 20 char/line; 6 line/inch; 80 cps; 64 char ASCII uppercase only; directly accepts analog signals for chart recorder applications at infinitely variable speeds; graphic plotting; rotated printing; reverse linefeed; friction feed; 2.75 max width sensitized roll paper; RS-232 with handshaking; 5.75 by 10.75 by 6.25

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MX80/CMD will send all printer commands from DOS. BIGLETT/BAS prints large Graphic Letters. EPSON/SUB merges with BASIC programs allowing 2 letter mnemonic commands to be sent to printer. JKL Patches allow JKL in NEWDOS 80 1.0 & NEWDOS 2.1 to send graphics properly. DEMO/BAS tutorial program of use of printer. LABEL/BAS custom label making program with graphics. DEF-STATE/SUB allows one word BASIC commands for centered titles, titles with borders, etc. A great program package for EPSON fans. SPECIAL DEAL: \$24.95 with printer. \$34.95 separately. Specify Model 1 or III..disk only

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version for MX80, 80FT & MX100. This package includes updated versions of modules in original EPSON Pack. A screen oriented BIT IMAGE GRAPHICS generator utility is provided. Create your special characters, symbols, etc. directly on your monitor and then send to printer. Printout includes code to generate graphics and will save needed code as BASIC program line to disk. Then MERGE these into your BASIC program. Also demo programs showing use of Bit-Image graphics. Full documentation. INTRO SPECIAL: \$24.95 with printer or GRAFTRAX. \$34.95 separately. \$7.50 for update of old Epson Pack

**ZAP3** - Direct read/write access to any TRSDOS 1.2 or 1.3 sector. Disable Passwords & access levels. Self prompting. Modify any sector in HEX or ASCII. Includes many patches to TRSDOS 1.2 & 1.3. Also COPYIT to allow backups of SCRIPSIT, VISICALC, etc. Just....\$24.95

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We use the highest quality fiberglass **CONTROLLER BOARDS** with double sided glass epoxy board and gold plated contacts in our TCS systems. The finest switching **POWER SUPPLY** available is also provided. The aluminum **MOUNTING HARDWARE** has slotted holes for easy installation of the drives and includes all the power and data cables necessary to install the controller, drives and power supply.

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KIT 1 Controller, Power Supply & Mounting Hardware.....\$379  
KIT 2 Controller, Power Supply, Hardware & 1 Disk Drive.....\$595  
KIT 3 Controller, Power Supply, Hardware & 2 Disk Drives.....\$819  
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Westrex OEM Products  
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West Caldwell, NJ 07006  
(201) 227-7290

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Apalachin, NY 13732  
(607) 625-2161

**Malibu Electronics Corporation**

2301 Townsgate Rd.  
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165: impact, 10 by 9 dot matrix; 165 cps; graphics; RS-232; parallel; \$2295  
200: impact, 9 by 18 dot matrix, double pass; 132 char/line; 250 cps; 6 or 8 line/inch; 96 char ASCII (multiple fonts); bidirectional printing; graphics, 120 by 144 pixels; self test; friction and tractor feed; sheet or fanfold paper; RS-232, 110 to 9600 bps; 23.9 by 17.1 by 7; 41 lbs; \$2995

**Mannesman-Talley**

8024 South 180th St.  
Kent, WA 98031  
(206) 251-5524

MT-1800: impact, 7 by 9 dot matrix, double pass; 132 or 218 char/line; 200 cps; 6 or 8 line/inch; bidirectional printing; vertical tabs; double-width characters; compressed characters; paper-out indicator; self test; tractor feed; fanfold paper; RS-232, 300 to 9600 bps; parallel; 25.5 by 19.5 by 18.5; 63 lbs; \$2495

**Matchless Systems**

18444 Broadway  
Gardena, CA 90248  
(213) 327-1010

**MDS Trivex**

3180 Redhill Ave.  
Costa Mesa, CA 92626  
(714) 546-7781

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4426 South Century Dr.  
Salt Lake City, UT 84107  
(801) 263-3081  
88G: impact, 11 by 7 dot

matrix; 80 or 132 char/line; 100 cps; 6 or 8 line/inch; 96 char ASCII (draft- and high-quality fonts); bidirectional printing; graphics; friction or tractor feed; sheet, fanfold, or roll paper; RS-232, 1K char buffer; Centronics parallel; 16.3 by 10.8 by 6.3; 15 lbs; \$749

**Microtek Inc.**

9514 Chesapeake Dr.  
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Tekwriter-1 (formerly Bytewriter 1): impact, 7 by 7 dot matrix; 80 char/line; 80 cps; friction feed; sheet or roll paper; parallel Centronics, Apple II, or Atari; \$349

Tekwriter-2: impact, 9 by 9 dot matrix; 80 or 132 char/line; graphics; Centronics parallel

MT-80: impact, dot matrix; 80 char/line; 125 cps; 96 char ASCII; tractor feed; fanfold paper; RS-232, 3K char buffer; parallel; \$795

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**Newman Computer Exchange Inc.**

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(313) 994-3200

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5 Militia Dr.  
Lexington, MA 02173  
5510: impact, thimble; 132 char/line; 55 cps; 6 or 8 line/inch; 128 char ASCII (multiple fonts); bidirectional printing; vertical tabs; paper-out indicator; friction and tractor feed; sheet or fanfold paper; cut-sheet feeder; RS-232, 110 to 1200 bps, 256 char buffer; 25 by 16.5 by 8.7; 45.5 lbs; \$3055

5520: impact, thimble; 132 char/line; 55 cps; 128 char ASCII (multiple fonts); friction or tractor feed; sheet or fanfold paper; cut-sheet feeder; RS-232, 110 to 1200 bps; \$3415

5530: impact, thimble; 132 char/line; 55 cps; 128 char ASCII (multiple fonts); friction or tractor feed; sheet or fanfold paper; cut-sheet feeder; parallel; \$3055

**Okidata Corporation**

111 Gaither Dr.  
Mount Laurel, NJ 08054  
(609) 235-2600

Microline 80: impact, dot matrix; 80 or 132 char/line; 80 cps; 96 char set; friction

and tractor feed; sheet or fanfold paper; parallel; \$475  
Microline 82A: impact, 9 by 9 dot matrix; 80 or 132 char/inch; 120 cps; 6 or 8 line/inch; short-line seeking; bidirectional printing; graphics; double-width characters; compressed characters; friction and tractor feed; sheet or fanfold paper; RS-232, 110 to 1200 bps; parallel; 14.2 by 12.9 by 5.2; 20 lbs; \$645

Microline 83: impact, dot matrix; 132 char/line; 120 cps; 96 char ASCII; bidirectional printing; tractor feed adjustable to 15 inches wide; fanfold paper; RS-232; parallel

SL300: impact, dot matrix whole-line printer; 132 char/line; 300 lpm; 96 char ASCII; software selectable fonts, oversized chars; barcode font; graphics; tractor feed; parallel; \$3995

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(914) 631-3000

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DY-311: impact, daisy wheel; 150 char/line; 32 cps; 5 or 6 line/inch; 96 char ASCII; bidirectional printing; manually changeable print element; friction or tractor feed; sheet or fanfold paper; RS-232, 100 to 9600 bps; parallel; 39.5 lbs; \$2850

DY-811: impact, daisy wheel; 150 char/line; 65 cps; 5 or 6 line/inch; 96 char ASCII; bidirectional printing; manually changeable print element; friction or tractor feed; sheet or fanfold paper; RS-232, 110 to 9600 bps; parallel; 79 lbs; \$4280

DM80/180: impact, 8 by 7 dot matrix; 150 char/line; 80 cps; 5 or 6 line/inch; 96 char ASCII; bidirectional printing; friction or tractor feed; sheet or fanfold paper; RS-232, 110 to 9600 bps; parallel; 79 lbs; \$4280

**Pertec Computer Company**

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Stylist 360: impact, daisy wheel; 198 char/line; 17 cps; 100 char modified ASCII; bidirectional printing; fric-

tion feed; sheet or fanfold paper; RS-232; parallel; 20.9 by 13 by 5.5; 29 lbs; \$1500

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Benton Harbor, MI 49022  
(616) 925-3200  
910: impact, 9 by 9 dot matrix; 80 char/line; 170 cps; 96 char ASCII, programmable character set; double-width characters; bidirectional printing; tractor feed; fanfold paper; RS-232, 1800 char buffer; parallel; 23 by 17 by 7; \$1695  
920: same as 910 except: 340 cps; \$2345

**Printer Terminal Communications Corporation**

124 10th St.  
Ramona, CA 92065  
879: impact, 7 by 9 dot matrix; 80 or 132 char/line; 180 cps; 6 line/inch; 96 char ASCII; bidirectional printing; vertical tabs; compressed characters; friction and tractor feed; sheet, fanfold, or roll paper; RS-232, 300 to 9600 bps, 256 char buffer; parallel; 18 by 22 by 7.5; 25 lbs; \$1299

**Printronix**

17421 Derian Ave.  
Irvine, CA 92713  
(714) 549-8272

**Qantex**

60 Plant Ave.  
Hauppauge, NY  
(516) 582-6060

**Qume Corporation**

2350 Qume Dr.  
San Jose, CA 95131  
(408) 942-4000  
Sprint 5/45: impact, daisy wheel; 132 char/line; 45 cps; friction or tractor feed; sheet or fanfold paper; cut-sheet feeder; RS-232; parallel; \$3137

Sprint 5/55: impact, daisy wheel; 132 char/line; 55 cps; 3 to 8 line/inch; manually changeable print element; bidirectional printing; vertical tabs; graphics; paper-out indicator; self test; friction feed; sheet paper; RS-232, 110 to 9600 bps; 24.3 by 16.8 by 6.5; 45 lbs; \$3726

Sprint 9/35: impact, daisy wheel; 132 char/line; 35 cps; manually changeable print element; friction or tractor feed; sheet or fanfold paper; RS-232; parallel

Sprint 9/45: same as 9/35 except: 45 cps  
Sprint 9/55: same as 9/35 except: 55 cps  
Sprint Wide-Track: impact, daisy wheel; 240 char/line; 55 cps; manually changeable



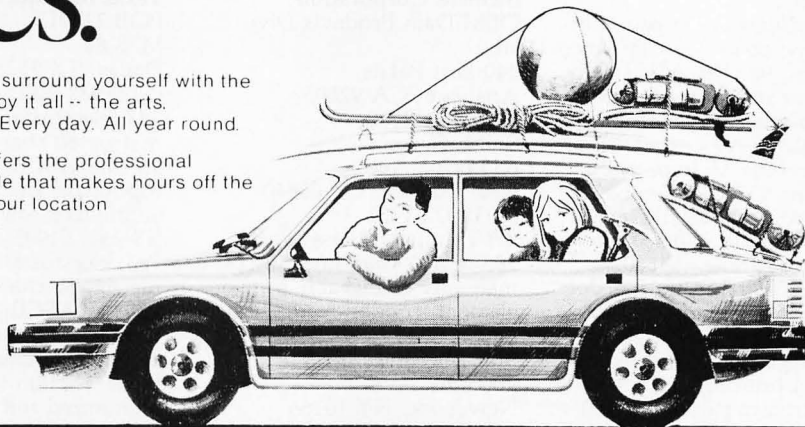
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Better skiing - 180 min.  
Sailing - 15 min.  
Golf - 17 min.  
Running - change your shoes  
Cricket - 23 min.  
Disneyland - 45 min.

Hollywood Bowl - 45 min.  
Universities - 30 min.  
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*Lineprinter IV*: impact, dot matrix; 80 or 132 char/line; 50 cps; 96 char ASCII; friction or tractor feed; sheet or fanfold paper; Centronics parallel; \$999

*Lineprinter V*: impact, dot matrix; 132 char/line; 120 cps; 96 char ASCII; tractor feed; fanfold paper; Centronics parallel; \$1860

*Lineprinter VI*: impact, dot matrix; 132 char/line; 100 cps; 96 char ASCII plus graphics characters; bidirectional printing; self test; Centronics parallel; \$1160

*Lineprinter VII*: impact, 5 by 7 dot matrix; 40 or 80 char/line; 30 cps; 6 line/inch; graphics; tractor feed; fanfold paper; RS-232, 100 to 600 bps; Centronics parallel; \$399

*Lineprinter VIII*: impact, 9 by 12 dot matrix; 80 char/line; 80 cps; 8 or 12 line/inch; graphics; bidirectional printing; short-line seeking; proportional spacing; friction or tractor feed; sheet, fanfold, or roll paper; self test; RS-232, 600 or 1200 bps; Centronics parallel; 15.4 by 11 by 4.7; 16.5 lbs; \$799

*Quick Printer II*: electrostatic, dot matrix; 16 char/line; 32 cps; uppercase only; compressed characters give 32 char/line at 64 cps; friction feed; aluminized roll paper 2.4 inches wide; \$219

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*DP-8480*: impact, 7 by 9 dot matrix; 132 char/line; 80 cps; 96 char ASCII; short-line seeking; bidirectional printing; graphics; double-width characters; compressed characters; self test; friction and tractor feed; sheet or fanfold paper; RS-232, 256 char buffer; 15.3 by 12.2 by 4.9; 19 lbs; \$495

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POB 18  
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*Typrinter*: impact, daisy wheel; 180 char/line; 12 cps; manually changeable print element; friction feed; fanfold paper; parallel; \$599

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(307) 856-7111

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*3431*: impact, 9 by 9 dot matrix; 136 char/line; 150 cps; 6 or 8 line/inch; 94 char ASCII; bidirectional printing; double-width characters; paper-out indicator; self test; tractor feed; fanfold paper; RS-232, 110 to 9600 bps, 256 char buffer; parallel

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Los Angeles, CA 90066  
(213) 390-9494

#### **Teletype Corporation**

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Skokie, IL 60077  
(312) 982-2000  
43; impact, dot matrix; 80 or 132 char/line; 30 cps; 96 char ASCII; friction or tractor feed; RS-232; \$1388

#### **Texas Instruments**

POB 225012  
M/S 84  
Dallas, TX 75265  
(312) 982-2000  
743: electrostatic, dot matrix; 80 char/line; 30 cps; 96 char ASCII; APL char set (optional); friction feed; aluminized roll paper; RS-232; \$1995  
765: electrostatic, dot matrix; 80 char/line; 30 cps; 96 char ASCII; bubble-memory storage up to 80K char; dual communications ports; friction feed; aluminized roll paper; RS-232 (integral modem optional); \$2995

810: impact, 9 by 7 dot matrix; 132 char/line; 150 cps; 6 or 8 line/inch; 64 char modified ASCII (96 char ASCII optional); double-width characters (optional); compressed characters (optional); bidirectional printing; vertical tabs; paper-out indicator; self test; tractor feed; fanfold paper; RS-232, 110 to 9600 bps; \$2165  
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2231 W-1: impact, 7 by 9 dot matrix; 112 char/line; 120 cps; 96 char ASCII; vertical tabs; double-width characters; paper-out indicator; self test; Wang serial interface, 112 char buffer; 24 by 18 by 10; 60 lbs; \$2900

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Ithaca, NY 14850  
(607) 272-1132  
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Xerox Square  
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(716) 423-3411  
1730: impact, daisy wheel; 132 char/line; 40 cps; manually changeable print element; friction feed; sheet paper; RS-232; \$2710  
1740: impact, daisy wheel; 132 char/line; 45 cps; manually changeable print element; friction feed; sheet paper; RS-232; \$3375  
1750: impact, daisy wheel; 132 char/line; 45 cps; manually changeable print element; friction feed; sheet paper; RS-232; \$3555

#### **Xymec Inc.**

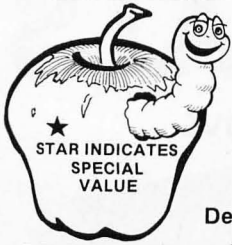
17905 J Sky Park Circle  
Irvine, CA 92714  
(714) 423-3411  
*HY-Q 1000*: impact, daisy wheel; 198 char/line; 20 cps; manually changeable print element; boldface characters; paper-out indicator; self test; RS-232; parallel  
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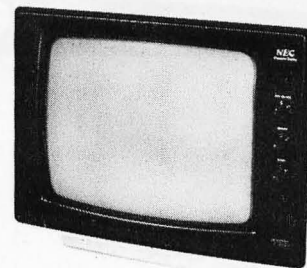


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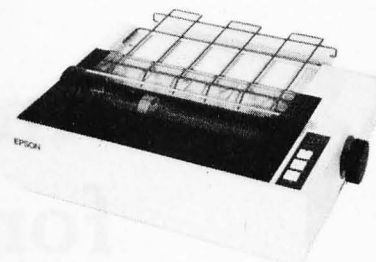
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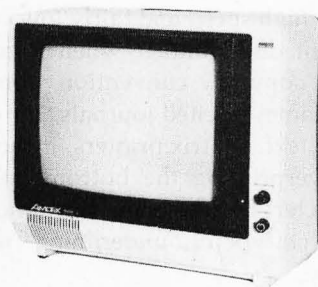
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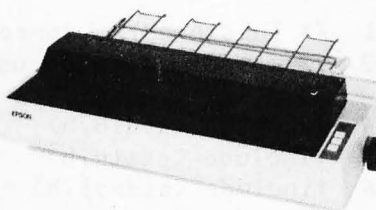
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## An Underline Filter for Matrix Printers

---

Adam Reed  
Center for Human Information Processing  
UCSD C-009  
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---

Although matrix printers such as Digital Equipment Corporation's Decwriter III have the advantages of relatively high speed and fairly low cost, they do have an important disadvantage when it comes to printing manuscript copy. By convention, some items in manuscripts (the names of cited journals, for example) are underlined in the text. Matrix printers, if they underline at all, do so by overprinting the bottom line of each "underlined" character. Besides being slow and aesthetically unappealing, this type of "underlining" makes the text nearly illegible.

Fortunately, many matrix printers, including the Decwriter, can achieve half-line vertical spacing. The program in listing 1 sets this option, converts the underline

characters to minus signs (which are the same length as underline characters on most matrix printers, including the Decwriter), then moves them onto a separate line to be printed under the corresponding line of text. The result is clear, fast, legible underlining. At the end of the text file, the program restores the Decwriter to normal vertical spacing.

The program in listing 1 is written in C to act as a "filter" under the Unix operating system. Its input is a text file with standard underlining, and its output is the input to the matrix printer. It can be translated readily into other languages, such as BASIC or FORTRAN, for use with other operating systems and matrix printers. ■

Listing 1.

```
1 /* This program improves Decwriter underline handling by using a line buffer */
2 /* and may also be used to change, temporarily, the dw3's horizontal pitch. */

4 #include <stdio.h>
5 #include <stty.h>
6 #include <signal.h>

8 int dwreset();

10 main(argc,argv) int argc; char *argv[]; {

12     register char c, h, *p;
13     int b, n;
```

Listing 1 continued on page 302



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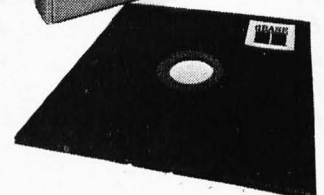
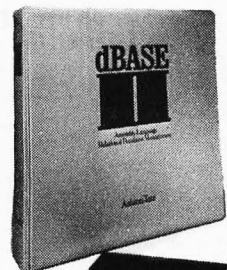
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## Programming Quickies

Listing 1 continued:

```
14      char opstrings[256] ;
15      char *option = opstrings ;
16      char *pmax, *plast;
17      static char buf[256];
18      setbuf( stdout, (char *)malloc( BUFSIZ ));

20      /* Make sure to reset decwriter if interrupted */

22      signal(SIGHUP, dwreset);
23      signal(SIGINT, dwreset);
24      signal(SIGQUIT, dwreset);
25      signal(SIGKILL, dwreset);
26      signal(SIGPIPE, dwreset);
27      signal(SIGALRM, dwreset);
28      signal(SIGTERM, dwreset);

30      /* Get the option from the command */
31
32      strcat (option, argv[1]) ;
33      if (*option == NULL) c = '2';
34      else {
35          c = *option++;
36          if (c == '+' || c == '-') c = *option++ ;
37          if (c == 'l') c = *option++ ;
38          if (c == 'p' || c == 'P') c = '0' ;
39          if (c == 'n' || c == 'N') c = '6' ;
40          if (c == 'w' || c == 'W') c = '8' ;
41      }
42      /* Then, initialize the Decwriter */
43
44      putchar(27); printf("[3z");
45      putchar(27); printf("[132t");
46      putchar(27); printf("[1,132r");
47      putchar(27);
48      if      (c == '0'){printf("[1w");putchar(27);printf("[1;84s");}
49      else if (c == '6'){printf("[4w");putchar(27);printf("[1;140s");}
50      else if (c == '8'){printf("[8w");putchar(27);printf("[1;70s");}
51      else      {printf("[2w");putchar(27);printf("[1;102s");}
52
53      /* Then process the file: */
54
55      c=getchar();
56      while ( c != EOF ) {
57          /* Main loop: process each line in turn: */
58
59
60
61
62          h=b=0;
63          plast=pmax= &buf[255];
64          p=buf;
65          while ( p<plast ) *p++ = 32;      /* clear under line buffer */
66          plast=p=buf;
67          while ( c!=10 && c!=EOF && c!= 13 && p<pmax ) {
68
69              /* loop for processing characters. */
```

Listing 1 continued on page 304



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## Programming Quickies

Listing 1 continued:

```

71      if ( c== 3 ) dwreset(); /* catch interrupt signals */
73
74      if ( c=='\t' ) {          /* tab both text and ul line */
75          putchar ( '\t' );
76          *p++ = '\t';
77          if (plast<p) plast=p;
78      }
79      else if ( c=='_' ) {      /* underline, backspace? */
80          if ((c = getchar()) == '\b') {
81              b=2;
82          }
83          else {
84              *p++ = '-';
85              if (plast<p) plast=p;
86              putchar(32);
87              h=1; /* a character is waiting */
88          }
89      }
90      else if ( c=='\b' ) {     /* backspace, underline? */
91          if ((c = getchar()) == '_') {
92              if (plast<p) plast=p;
93              *(p-1) = '-';
94          }
95          else {
96              h = 1;
97              putchar('\b');
98              --p;
99          }
100      }
101      else {                    /* ordinary char */
102          putchar(c);
103          ++p;
104          if ( b==2 ) { /* previously underlined char */
105              b = 0;
106              if (plast<p) plast=p;
107              *(p-1) = '-';
108          }
109      }
110      if ( h==1 ) h=0;          /* character read already */

```

Listing 1 continued on page 306





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## Programming Quickies

Listing 1 continued:

```
110             else c=getchar();
111         }
112         putchar (10);           /* go down to underline position */
113         p=buf;
114         while ( p<plast ) {      /* output and clear under line */
115             putchar(*p);
116             *p++ = 32;
117         }
118         plast=buf;
119         putchar(10);
120         if ( c!=10 && c!=13 ) break; /* any c other than LF or CR */
121                                     /* at end-of line indicates error */
122         c=getchar();             /* otherwise get first c in new line */
123                                     /* or EOF */
124     }
125
126     /* after EOF the end is near, so reset decwriter to normal mode */
127
128     alarm(120);
129     dwreset();
130
131 }                                     /* THE END */
132
133 dwreset() {                         /* Subroutine to reset the decwriter to normal mode */
134
135     signal(SIGINT,SIG_IGN);
136     putchar(27); printf("[1z");
137     putchar(27); printf("[66t");
138     putchar(27); printf("[1,66r");
139     putchar(27); printf("[2w");
140     putchar(27); printf("[1,102s");
141     exit();
142
143 }
```

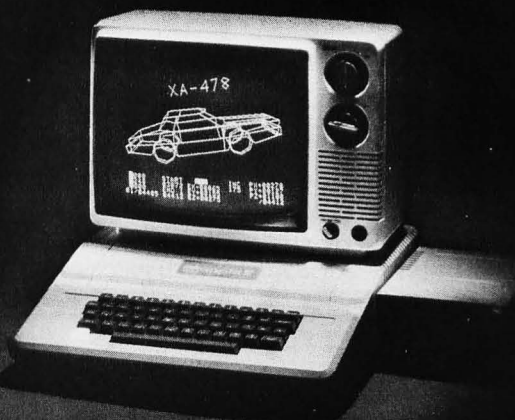
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## CARD GAMES

- BACCARAT (Atari only)** Price: \$18.95 Cassette/\$22.95 Diskette  
This is the European card game which is the favorite of the Monte Carlo jet set. Imagine yourself at the gaming table with 007 to your left and Goldfinger to your right. Learn and play BACCARAT at your leisure on the Atari. Contains full high resolution color graphics and matching sound. Runs in 16K. Requires one joystick.
- GIN RUMMY (Apple only)** Price: \$18.95 Cassette/\$22.95 Diskette  
This is the best micro computer implementation of GIN RUMMY existing. The computer plays exceptionally well, and the HIREX graphics are superb. What else can be said?
- POKER PARTY (Available for all computers)** Price: \$17.95 Cassette/\$21.95 Diskette  
POKER PARTY is a draw poker simulation based on the book, POKER, by Oswald Jacoby. This is the most comprehensive version available for microcomputers. The party consists of yourself and six other (computer) players. Each of these players (you will get to know them) has a different personality in the form of a varying propensity to bluff or fold under pressure. Practice with POKER PARTY before going to that expensive game tonight! Apple cassette and diskette versions require a 32 K (or larger) Apple II.
- GO FISH (Available for all computers)** Price: \$14.95 Cassette/\$19.95 Diskette  
GO FISH is a classic children's card game. The opponent is a friendly computer with user inputs that are simple enough for small children to easily master. The Apple and Atari versions employ high resolution graphics for the display of hands. A must for children!

## THOUGHT PROVOKERS

- MANAGEMENT SIMULATOR (Atari, North Star, OSBORNE and CP/M only)** Price: \$19.95 Cassette/\$23.95 Diskette  
This program is both an excellent teaching tool as well as a stimulating intellectual game. Based upon similar games played at graduate business schools, each player or team controls a company which manufactures three products. Each player attempts to outperform his competitors by setting selling prices, production volumes, marketing and design expenditures etc. The most successful firm is the one with the highest stock price when the simulation ends.
- FLIGHT SIMULATOR (Available for all computers)** Price: \$17.95 Cassette/\$21.95 Diskette  
A realistic and extensive mathematical simulation of take-off, flight and landing. The program utilizes aerodynamic equations and the characteristics of a real airfoil. You can practice instrument approaches and navigation using radials and compass headings. The more advanced flyer can also perform loops, half-rolls and similar acrobatic maneuvers. Although this program does not employ graphics, it is exciting and very addictive. See the software review in COMPUTRONICS. Runs in 16K Atari.
- VALDEZ (Available for all computers)** Price: \$15.95 Cassette/\$19.95 Diskette  
VALDEZ is a computer simulation of superlunar navigation in the Prince William Sound/Valdez Narrows region of Alaska. Included in this simulation is a realistic and extensive 256 x 256 element map, portions of which may be viewed using the ship's alphanumeric radar display. The motion of the ship itself is accurately modeled mathematically. The simulation also contains a model for the tidal patterns in the region, as well as other traffic (outgoing tankers and drifting icebergs). Chart your course from the Gulf of Alaska to Valdez Harbor! See the software reviews in 80 Software Critique and Personal Computing.
- BACKGAMMON 2.0 (Atari, North Star, OSBORNE and CP/M only)** Price: \$14.95 Cassette/\$18.95 Diskette  
This program tests your backgammon skills and will also improve your game. A human can compete against a computer or against another human. The computer can even play against itself. Either the human or the computer can double or forfeit dice rolls. Board positions can be created or saved for replay. BACKGAMMON 2.0 plays in accordance with the official rules of backgammon and is sure to provide many fascinating sessions of backgammon play.
- CHESS MASTER (North Star and TRS-80 only)** Price: \$19.95 Cassette/\$23.95 Diskette  
This complete and very powerful program provides five levels of play. It includes castling, en passant captures and the promotion of pawns. Additionally, the board may be preset before the start of play, permitting the examination of "book" plays. To maximize execution speed, the program is written in assembly language (by SOFTWARE SPECIALISTS of California). Full graphics are employed in the TRS-80 version, and two widths of alphanumeric display are provided to accommodate North Star users. See review in onComputing.
- SUPER SUB CHASE (Atari only)** Price: \$19.95 Cassette/\$23.95 Diskette  
SUPER SUB CHASE simulates a search and destroy mission. Set your course and keep an eye on the sonar readings as you hunt for the hidden submarine. Set the depth charge explosion depth and watch them sink towards the sub. This is an addictive game which takes advantage of the Atari's graphics and sound capabilities. One or two players. Joystick(s) required.
- FOREST FIRE! (Atari only)** Price: \$15.95 Cassette/\$19.95 Diskette  
Using excellent graphics and sound effects, this simulation puts you in the middle of a forest fire. Your job is to direct operations to put out the fire while compensating for changes in wind, weather and terrain. Not protecting valuable structures can result in startling penalties. Life-like variables are provided to make FOREST FIRE! very suspenseful and challenging. No two games have the same setting and there are 3 levels of difficulty.
- BLACK HOLE (Apple only)** Price: \$14.95 Cassette/\$18.95 Diskette  
This is an exciting graphical simulation of the problems involved in closely observing a black hole with a space probe. The object is to enter and maintain, for a prescribed time, an orbit close to a small black hole. This is to be achieved without coming so near the anomaly that the tidal stress destroys the probe. Control of the craft is realistically simulated using side jets for rotation and main thrusters for acceleration. This program employs Hi-Res graphics and is educational as well as challenging.
- SPACE EVACUATION! (Apple, Atari and TRS-80 only)** Price: \$15.95 Cassette/\$19.95 Diskette  
Can you colonize the galaxy and evacuate the Earth before the sun explodes? Your computer becomes the ship's computer as you explore the universe to relocate millions of people. This simulation is particularly interesting as it combines many of the exciting elements of classic space games with the mystery challenge of ADVENTURE.
- MONARCH (Atari only)** Price: \$11.95 Cassette/\$15.95 Diskette  
MONARCH is a fascinating economic simulation requiring you to survive an 8-year term as your nation's leader. You determine the amount of acreage devoted to industrial and agricultural use, how much food to distribute to the populace and how much should be spent on pollution control. You will find that all decisions involve a compromise and that it is not easy to make everyone happy. Runs in 16K Atari.
- CHOMPELO (Atari only)** Price: \$11.95 Cassette/\$15.95 Diskette  
CHOMPELO is really two challenging games in one. One is similar to NIM; you must bite off part of a cookie, but avoid taking the poisoned portion. The other game is the popular board game REVERSI. It fully uses the Atari's graphics capability, and is hard to beat. This package will run on a 16K system.
- SPACE LANES (Available for all computers)** Price: \$10.95 Cassette/\$14.95 Diskette  
SPACE LANES is a simple but exciting space transportation game which involves up to four players (including the computer). The object is to form and expand space transportation companies in a competitive environment. The goal is to amass more net worth than your opponent. The economics include stock purchases and company mergers. Watch your wealth grow!

## AVAILABILITY

DYNACOMP software is supplied with complete documentation containing clear explanations and examples. Unless otherwise specified, all programs will run within 16K computer memory space (ATARI requires 24K). Except where noted, programs are available on ATARI, PET, TRS-80 (Level II) and Apple (AppleII) cassette and diskette as well as North Star single density (double density compatible) diskette. Additionally, most programs can be obtained on standard (IBM 3740 single density/double density compatible format) 8" CP/M floppy disks for systems running under MBASIC (for example, Altos, Xerox 820 and many others). 5 1/4" CP/M diskettes are available for the North Star and Osborne computer systems.

\*ATARI, PET/CBM, NORTH STAR, CP/M, IBM, OSBORNE and XEROX are registered trademarks and/or trade marks.  
\*\*Except where noted, all TRS-80 Model I software is available on cassette (only) for the TRS-80 Model III. Exceptions: VALDEZ, CRIBAGE, GRAFIX, CHESSMASTER. TRS-80 diskettes are not supplied with either DOS or BASIC.  
\*\*\*For most North Star disk-based systems. DYNACOMP presently does not support the new North Star Advantage.  
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- LIL' MEN FROM MARS (Atari only)** Price: \$19.95 Cassette/\$23.95 Diskette  
Defend yourself! The little men from Mars are out to get you if you don't get them first. This is a hilarious high resolution animated graphics (arcade) game which exercises much of the Atari's power. Requires one joystick.
- SPACE TILT (Apple and Atari only)** Price: \$10.95 Cassette/\$14.95 Diskette  
Use the game paddles to tilt the plane of the TV screen so "roll" a ball into a hole in the screen. Sound simple? Not when the hole gets smaller and smaller! A built-in timer allows you to measure your skill against others in this habit-forming action game.
- ESCAPE FROM VOLANTUM (Atari only)** Price: \$15.95 Cassette/\$19.95 Diskette  
Bring the action and excitement of an arcade into your home with ESCAPE FROM VOLANTUM! To escape you must maneuver your space ship around obstacles and laser blast the dragon (without being eaten). If he is killed with a direct shot (not just a leg lopped off), a door opens to the outside. However, the door does not stay open indefinitely. If you fail to escape in time, the door closes and a new dragon appears. Sometimes you can smash through the door by repeatedly chipping away at it. Other times it is impervious. At the higher levels of play more obstacles and dragons appear, adding to the excitement. Uses high resolution graphics and sound. Runs in 16K.
- ALPHA FIGHTER (Atari only)** Price: \$13.95 Cassette/\$17.95 Diskette  
Two excellent graphics and action programs in one! ALPHA FIGHTER requires you to destroy the alien starships passing through your sector of the galaxy. ALPHA BASE is in the path of an alien UFO invasion; let five UFO's get by and the game ends. Both games require the joystick and get progressively more difficult the higher you score! ALPHA FIGHTER will run on 16K systems.
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The empire has developed a new battle station protected by rotating rings of energy. Each time you blast through the rings and destroy the station, the empire develops a new station with more protective rings. This exciting game runs on 16K systems, employs extensive graphics and sound and can be played by one or two players.
- INTRUDER ALERT (Atari only)** Price: \$15.95 Cassette/\$19.95 Diskette  
This is a fast paced graphics game which places you in the middle of the "Dreadstar" having just stolen its plans. The droids have been alerted and are directed to destroy you at all costs. You must find and enter your ship to escape with the plans. Five levels of difficulty are provided. INTRUDER ALERT requires a joystick and will run on 16K systems.
- MIDWAY (Atari only)** Price: \$14.95 Cassette/\$18.95 Diskette  
MIDWAY is an exciting extension of the game of Battleship. It mixes the challenges of strategy and chance. Your opponent can be another human or the computer. Color graphics and sound are both included. Runs in 16K.
- TRIPLE BLOCKADE (Atari only)** Price: \$14.95 Cassette/\$18.95 Diskette  
TRIPLE BLOCKADE is a two-to-three player graphics and sound action game. It is based on the classic video arcade game which millions have enjoyed. Using the Atari joystick(s), the object is to direct your blockading line around the screen without running into your opponent(s). Although the concept is simple, the combined graphics and sound effect lead to "high anxiety".
- GAMES PACK I (Available for all computers)** Price: \$10.95 Cassette/\$14.95 Diskette  
GAMES PACK I contains the classic computer games of BLACKJACK, LUNAR LANDER, CRAPS, HORSESHOE, SWITCH and more. These games have been combined into one large program for ease in loading. They are individually accessed by a convenient menu. This collection is worth the price just for the DYNACOMP version of BLACKJACK.
- GAMES PACK II (Available for all computers)** Price: \$10.95 Cassette/\$14.95 Diskette  
GAMES PACK II includes the games CRAZY EIGHTS, JOTTO, ACEY-DUCEY, LIFE, WUMPUS and others. As with GAMES PACK I, all the games are loaded as one program and are called from a menu. You will particularly enjoy DYNACOMP's version of CRAZY EIGHTS.  
Why pay \$7.95 or more per program when you can buy a DYNACOMP collection for just \$10.95?
- MOON PROBE (Atari and North Star only)** Price: \$11.95 Cassette/\$15.95 Diskette  
This is an extremely challenging "lunar lander" program. The user must drop from orbit to land at a predetermined target on the moon's surface. You control the thrust and orientation of your craft plus direct the rate of descent and approach angle. Runs in 16K Atari.
- SPACE TRAP (Atari only, 16K)** Price: \$14.95 Cassette/\$18.95 Diskette  
This galactic "shoot 'em up" arcade game places you near a black hole. You control your spacecraft using the joystick and attempt to blast as many of the alien ships as possible before the black hole closes about you.
- CHIRP INVADERS (PET/CBM only)** Price: \$14.95 Cassette/\$18.95 Diskette  
CHIRP INVADERS is an addictive game using action graphics. A Federation space station must be reached before the Chirps conquer the Earth. Stationary obstacles, moving meteors, and the attacking Chirps must all be avoided for a successful journey. Good luck.

## ADVENTURE

- CRANSTON MANOR ADVENTURE (North Star and CP/M only)** Price: \$19.95 Diskette  
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- GUMBALL RALLY ADVENTURE (North Star only, 48K)** Price: \$21.95 Diskette  
Take part in this outlaw race from the east coast to the west coast. The goal is to find your way to the finish line while maintaining the highest possible speed. You may choose one of five cars available at the garage. The choice will affect your speed and range. Remember to take spare parts and don't get caught speeding!
- UNCLE HARRY'S WILL (North Star only, 40K)** Price: \$24.95 Diskette  
Uncle Harry has died and has left you everything. However, he has neglected to mention where everything is! Instead, his will consists of a poem which contains clues. You will have to travel all over the United States both by car and on foot to solve the puzzle, and there are over 300 locations to probe. Be careful and watch out for red herrings!

## SPEECH SYNTHESIS

DYNACOMP is now distributing the new and revolutionary TYPE-N-TALK™ (TNT) speech synthesizer from Votrax. Simply connect TNT to your computer's serial interface, enter text from the keyboard and hear the words spoken. TNT is the easiest-to-program speech synthesizer on the market. It uses the least amount of memory and provides the most flexible vocabulary available anywhere!

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- TALK TO ME (TNT Atari only, 24K)** Price: \$14.95 Cassette/\$18.95 Diskette  
This program presents a superb tutorial on speech synthesis using the Atari 800 and TYPE-N-TALK™. TALK TO ME will illustrate normal word generation as well as phoneme generation. The documentation includes many helpful programming tips. TALK TO ME has been demonstrated on network (CBS) TV!

## MISCELLANEOUS

- CRYSTALS (Atari only)** Price: \$ 9.95 Cassette/\$13.95 Diskette  
A unique algorithm randomly produces fascinating graphics displays accompanied with tones which vary as the patterns are built. No two patterns are the same, and the combined effect of the sound and graphics are mesmerizing. CRYSTALS has been used in local stores to demonstrate the sound and color features of the Atari. Runs in 16K Atari.
- NORTH STAR SOFTWARE EXCHANGE (NSSE) LIBRARY**  
DYNACOMP now distributes the 23 volume NSSE library. These diskettes each contain many programs and offer an outstanding value for the purchase price. They should be part of every North Star user's collection. Call or write DYNACOMP for details regarding the contents of the NSSE collection.  
Price: \$9.95 each/\$7.95 each (4 or more)  
The complete collection may be purchased for \$149.95



## BUSINESS and UTILITIES

**MAILMASTER (Atari diskette only)** Price: \$39.95 Diskette  
MAILMASTER is a very versatile software package for managing and manipulating mail lists and mini data bases. Each disk can hold over 700 customer entries containing name, address, three 3-letter key words and a phone number. The display is marked so that entries may be made and edited with ease. The software (e.g., disk space left, options, etc.) is shown at all times. Labels may be printed 1,2 or 3 up, and all sorting (zip code and alphabetic) is performed by a fast machine language program.

**PERSONAL FINANCE SYSTEM (Atari and North Star only)** Price: \$39.95 Diskette  
PFS is a single diskette, menu-oriented system composed of ten different programs. Besides recording your expenses and tax deductible items, PFS will sort and summarize expenses by payee, and display information on expenditures by any of 26 user defined codes by month or by payee. PFS will even produce monthly bar graphs of your expenses by category! This powerful package requires only one disk drive, minimal memory (24K Atari, 32K North Star) and will store up to 600 records per disk (and over 1000 records per disk if using a file simple changes to the programs). You can record checks plus cash expenses so that you can finally see where your money goes and eliminate guesswork and tedious hand calculations. Contains high speed machine language sort. PFS has been demonstrated on network (CBS) TV!

**FAMILY BUDGET (Apple and Atari only)** Price: \$34.95 Diskette  
FAMILY BUDGET is a very convenient financial record-keeping program. You will be able to keep track of cash and credit expenditures as well as income on a daily basis. You can record tax deductible items and charitable donations. FAMILY BUDGET also provides a continuous record of all credit transactions. You can make daily cash and charge entries to any of 21 different expense accounts as well as to 5 payroll and tax accounts. Data are easily retrieved giving the user complete control over an otherwise complicated (and unorganized!) subject.

**INTELINK (Atari only)** Price: \$49.95 Diskette  
This software package contains a menu-driven collection of programs for facilitating efficient two-way communications through a full duplex modem (required for use). In one mode of operation you may connect to a data service (e.g., the SOURCE or MicroNet) and quickly load data such as stock quotations onto your diskette for later viewing. This greatly reduces "connect time" and thus the service charge. You may also record the complete contents of a communications session. Additionally, programs written in BASIC, FORTRAN, etc. may be built off-line using the support text editor and later "up-loaded" to another computer, making the Atari a very smart terminal. Even Atari BASIC programs may be uploaded. Further, a command file may be built off-line and used later as controlling input for a time-share system. That is, you can set up your sequence of time-share commands and programs, and the Atari will transmit them as needed; batch processing. All this adds up to saving both connect time and your time.

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DYNACOMP is a leading distributor of small system software with sales spanning the world (currently in excess of 50 countries). During the past three years we have greatly enlarged the DYNACOMP product line, but have maintained and improved our high level of quality and customer support. The achievement in quality is apparent from our many repeat customers and the software reviews in such publications as COMPUTRONICS, 80 Software Critique, A.N.T.O.G., Softalk, Creative Computing and Kilobaud. DYNACOMP software has also been chosen for demonstration on network television. Our customer support is as close as your phone. It is always friendly. The staff is highly trained and always willing to discuss products or give advice.



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# Programming Quickies

## A Shape-Drawing Program for Diablo Printers

Thomas D. Brock  
1227 Dartmouth Rd.  
Madison, WI 53705

The Diablo Model 1620 and 1640 daisy-wheel printers have a lot of nice graphics features that aren't generally used. After working with high-resolution graphics shape tables on the Apple II computer, I decided to write a shape-list generator for the Diablo in BASIC. [We call this construct a "shape list" to distinguish it from the binary-coded Apple shape tables....RSS]

The program I devised permits the definition of a variety of shapes and the printing of these shapes at any chosen size. No attempt has been made to write a complete graphics package, but the shape-list generator could easily be incorporated into a larger program. Changing the position of printing on the paper and rotating the shapes could also be added.

Each shape is defined in terms of the instructions needed to print it on the paper. The move and print instructions are coded into character strings that are interpreted by a series of subroutines. The program can be used on any BASIC interpreter that supports string variables and permits dissection of strings into substrings.

The details of the Diablo codes for graphics can be found in the Diablo user's manual. The printer is placed into graphics mode by sending to it an Escape, "3" sequence and is taken out of graphics mode through an Escape, "4" sequence. When in graphics mode, carriage movement is not tied to character printing, but space and backspace cause carriage movements of 1/60 inch forward and backward, respectively. Also the linefeed character causes paper-feed movement of 1/48 inch, and "negative linefeed," initiated by sending an Escape, linefeed sequence, causes paper movement of 1/48 inch in the opposite direction. Other paper-movement commands such as vertical tab, formfeed, and margin control remain unchanged.

Thus, to print a horizontal line, it is necessary to send an alternating sequence of periods (decimal ASCII code 46) and spaces or backspaces; the length of the line in inches will be 1/60 times the number of periods printed. To print a vertical line, one sends an alternating sequence of periods and linefeeds, or negative linefeeds; the length



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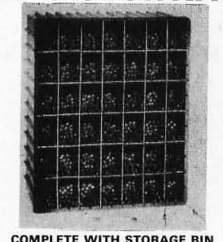
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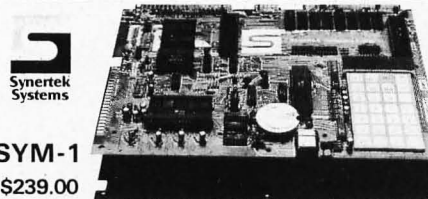
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12	120	1.2K	12K	120K	1.2M
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15	150	1.5K	15K	150K	1.5M
16	160	1.6K	16K	160K	1.6M
18	180	1.8K	18K	180K	1.8M
20	200	2.0K	20K	200K	2.0M
22	220	2.2K	22K	220K	2.2M
24	240	2.4K	24K	240K	2.4M
27	270	2.7K	27K	270K	2.7M
30	300	3.0K	30K	300K	3.0M
33	330	3.3K	33K	330K	3.3M
36	360	3.6K	36K	360K	3.6M
39	390	3.9K	39K	390K	3.9M
43	430	4.3K	43K	430K	4.3M
47	470	4.7K	47K	470K	4.7M
51	510	5.1K	51K	510K	5.1M
56	560	5.6K	56K	560K	5.6M
62	620	6.2K	62K	620K	6.2M
68	680	6.8K	68K	680K	6.8M
75	750	7.5K	75K	750K	7.5M
82	820	8.2K	82K	820K	8.2M
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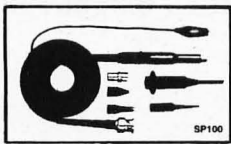
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## Programming Quickies

Listing 1: Diablo printer shape-table program in BASIC for the Apple II computer.

```
1  REM  DIABLO SHAPE TABLE GENERATOR
2  REM  BY THOMAS D. BROCK, MADISON, WI.
3  REM  FIRST DEFINE CODES FOR DIABLO.  E$=ESCAPE.SP$=SPACE.
4  REM  LF$=LINE FEED.G$=3.TX$=4.PE$=PERIOD (PRINT CHARACTER).
5  REM  BS$=BACKSPACE.NF$=NEGATIVE LINE FEED.
10 E$ = CHR$ (27):SP$ = CHR$ (32):LF$ = CHR$ (10):G$ = CHR$ (51)
11 TX$ = CHR$ (52):PE$ = CHR$ (46):BS$ = CHR$ (8)
12 NF$ = CHR$ (27) + CHR$ (10)
19  REM  SHAPE TABLE REFERENCES
20  INPUT "SHAPE#?";N
22  INPUT "SCALE?";S
28  REM  TURN ON PRINTER.INITIALIZE GRAPHICS MODE
30  PR# 3: PRINT " ";E$;G$;
40  ON N GOSUB 1000,1100,1200,1300
45  GOTO 200
48  REM  MOVE AND PRINT ROUTINES
50  FOR I = 1 TO M * S
52  PRINT SP$;PE$;
54  NEXT I: RETURN
60  FOR I = 1 TO M * S
62  PRINT LF$;PE$;
64  NEXT I: RETURN
70  FOR I = 1 TO M * S
72  PRINT BS$;PE$;
74  NEXT I: RETURN
80  FOR I = 1 TO M * S
82  PRINT NF$;PE$;
84  NEXT I: RETURN
198 REM  RETURN TO TEXT MODE
200 PRINT E$;TX$;; PR# 0: END
998 REM  LINES 1000,1200 DEFINE SHAPES
999 REM  ANY SHAPES MAY BE INSERTED HERE
1000 SH$ = "L3D3R2XL2D3R3"
1001 GOSUB 5000: RETURN
1100 SH$ = "XD3L2U4R4D4L2"
1101 GOSUB 5000: RETURN
1200 SH$ = "XD3L2XL1XUL1U3XU1XR1R3XR1XD1D3XD1XL1L2": GOSUB 5000: RETURN
1998 REM  TEST FOR PRINT DIRECTION
2000 IF M$ = "R" THEN GOSUB 50
2010 IF M$ = "D" THEN GOSUB 60
2020 IF M$ = "L" THEN GOSUB 70
2030 IF M$ = "U" THEN GOSUB 80
2040 RETURN
4998 REM  INTERPRET STRING AS SHAPE
5000 FOR J = 1 TO LEN (SH$)
5020 IF MID$ (SH$,J,1) = "X" THEN PE$ = CHR$ (0):J = J + 1
5030 M$ = MID$ (SH$,J,1):J = J + 1:M = VAL ( MID$ (SH$,J,1)): GOSUB 2000
5100 PE$ = CHR$ (46): NEXT J
5200 RETURN
```

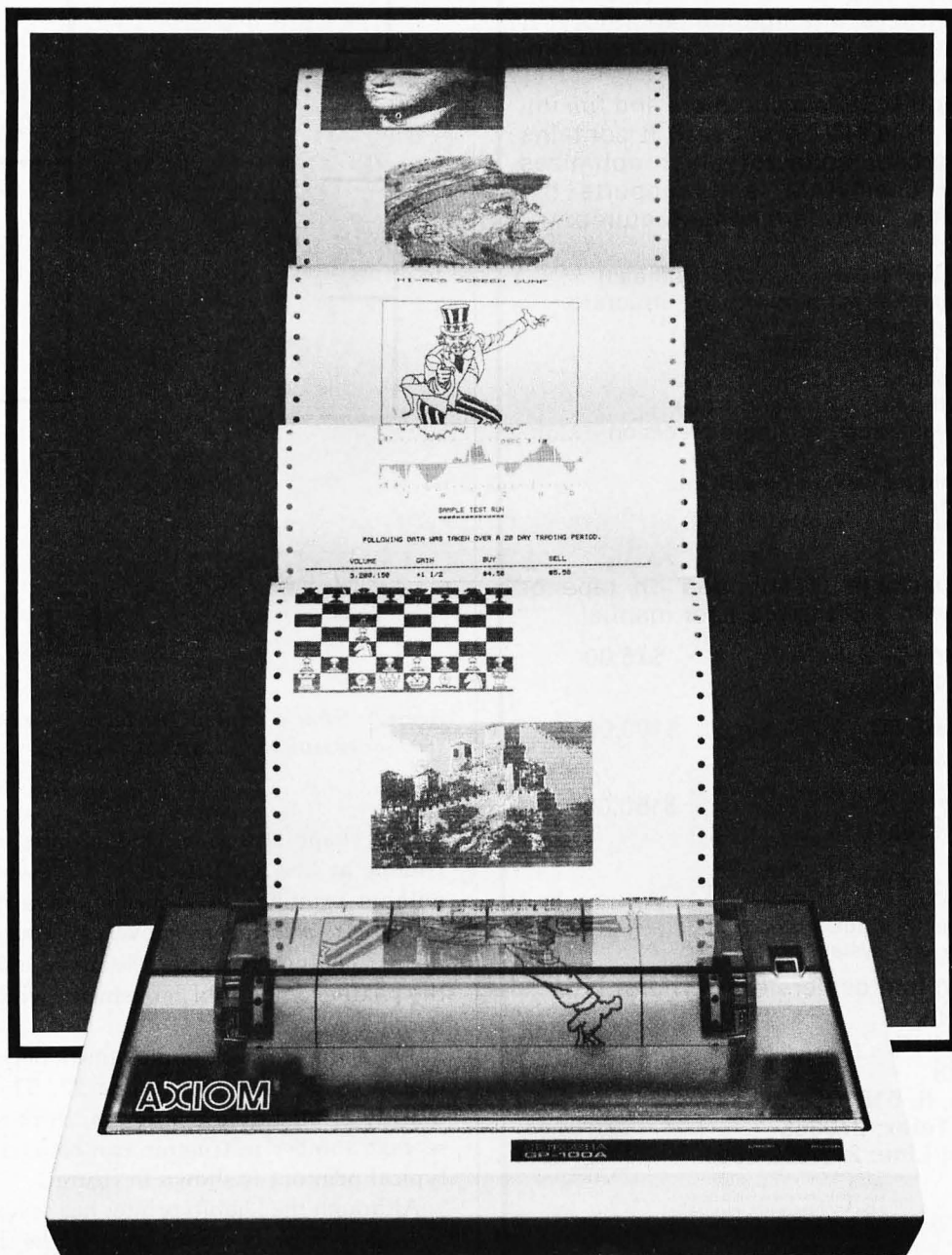
of the vertical line in inches will be 1/40 times the number of periods printed. To move the print head without printing a line, the print-head-movement command is sent without the corresponding periods.

The program in listing 1 is fairly self-explanatory. The shapes are stored as character strings in lines 1000 to 1200, and could, of course, also be input just before starting execution by a change in line 20.



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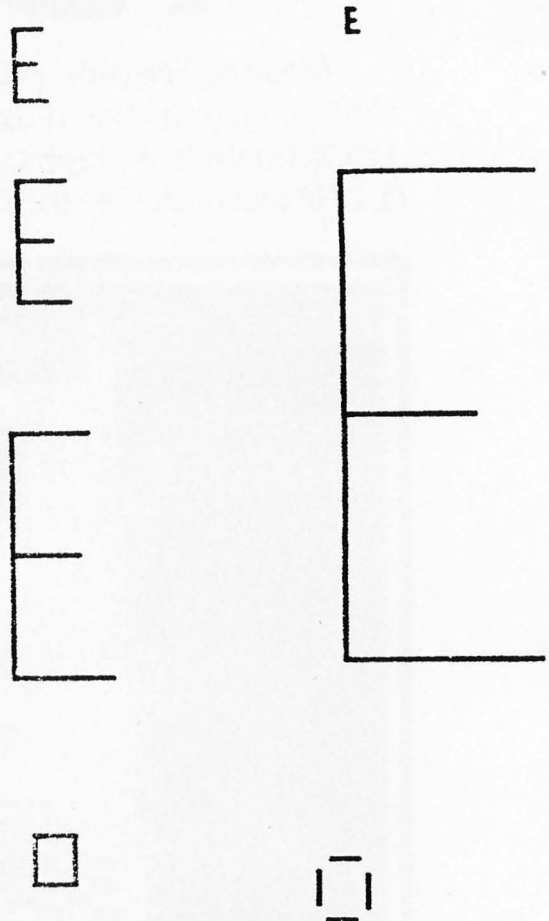


Figure 1: Sample printout produced on a Diablo printer of the 1600 series with the program of listing 1.

The shape string selected is interpreted in the sub-routine at line 5000. If an X is present, it means move without printing, an R means move right, an L means move left, a U means move up, and a D means move down. The number after the move instruction provides the relative amount of movement, which is stored in the variable M.

The actual amount of movement depends upon the size of the shape, selected at line 22. The whole shape is quickly printed by the program. Printing is then stopped so that another instruction can be fetched, if desired. A typical printout is shown in figure 1.

Although the Diablo printer has several different ways by which graphics can be created, the shape-list program provides a simple means to make nonnumerical drawings. By permitting the selection of any desired size (and position on the paper, with routines easily added) some useful tasks can be performed. Because of the simplicity and shortness of the program, it can be run with virtually any BASIC interpreter that supports string functions. ■



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6 BREAKVEN	Breakeven analysis
7 DEPRSL	Straightline depreciation
8 DEPRSY	Sum of the digits depreciation
9 DEPRDB	Declining balance depreciation
10 DEPRDDB	Double declining balance depreciation
11 TAXDEP	Cash flow vs. depreciation tables
12 CHECK2	Prints NEBS checks along with daily register
13 CHECKBKI	Checkbook maintenance program
14 MORTGAGE/A	Mortgage amortization table
15 MULTMON	Computes time needed for money to double, triple, etc.
16 SALVAGE	Determines salvage value of an investment
17 RRVARIN	Rate of return on investment with variable inflows
18 RRCONST	Rate of return on investment with constant inflows
19 EFFECT	Effective interest rate of a loan
20 FVAL	Future value of an investment (compound interest)
21 PVAL	Present value of a future amount
22 LOANPAY	Amount of payment on a loan
23 REGWITH	Equal withdrawals from investment to leave 0 over
24 SIMPDISK	Simple discount analysis
25 DATEVAL	Equivalent & nonequivalent dated values for oblig.
26 ANNUDEF	Present value of deferred annuities
27 MARKUP	% Markup analysis for items
28 SINKFUND	Sinking fund amortization program
29 BONDVAL	Value of a bond
30 DEPLETE	Depletion analysis
31 BLACKSH	Black Scholes options analysis
32 STOCVAL1	Expected return on stock via discounts dividends
33 WARVAL	Value of a warrant
34 BONDVAL2	Value of a bond
35 EPSEST	Estimate of future earnings per share for company
36 BETAALPH	Computes alpha and beta variables for stock
37 SHARPE1	Portfolio selection model-i.e. what stocks to hold
38 OPTWRITE	Option writing computations
39 RTVAL	Value of a right
40 EXPVAL	Expected value analysis
41 BAYES	Bayesian decisions
42 VALPRINF	Value of perfect information
43 VALADINF	Value of additional information
44 UTILITY	Derives utility function
45 SIMPLEX	Linear programming solution by simplex method
46 TRANS	Transportation method for linear programming
47 EOQ	Economic order quantity inventory model
48 QUEUE1	Single server queueing (waiting line) model
49 CVP	Cost-volume-profit analysis
50 CONDPFOT	Conditional profit tables
51 OPTLOSS	Opportunity loss tables
52 FQOQOQ	Fixed quantity economic order quantity model

59 WACC	Weighted average cost of capital
60 COMBAL	True rate on loan with compensating bal. required
61 DISCBAL	True rate on discounted loan
62 MERGANAL	Merger analysis computations
63 FINRAT	Financial ratios for a firm
64 NPV	Net present value of project
65 PRINDLAS	Laspeyres price index
66 PRINDPA	Paasche price index
67 SEASIND	Constructs seasonal quantity indices for company
68 TIMETR	Time series analysis linear trend
69 TIMEMOV	Time series analysis moving average trend
70 FUPRINF	Future price estimation with inflation
71 MAILPAC	Mailing list system
72 LETWRT	Letter writing system-links with MAILPAC
73 SORT3	Sorts list of names
74 LABEL1	Shipping label maker
75 LABEL2	Name label maker
76 BUSBJD	HOME business bookkeeping system
77 TIMECLK	Computes weeks total hours from timeclock info.
78 ACCTPAY	In memory accounts payable system-storage permitted
79 INVOICE	Generate invoice on screen and print on printer
80 INVENT2	In memory inventory control system
81 TELDIR	Computerized telephone directory
82 TIMUSAN	Time use analysis
83 ASSIGN	Use of assignment algorithm for optimal job assign.
84 ACCTREC	In memory accounts receivable system-storage ok
85 TERMSPAY	Compares 3 methods of repayment of loans
86 PAYNET	Computes gross pay required for given net
87 SELLPR	Computes selling price for given after tax amount
88 ARBCOMP	Arbitrage computations
89 DEPRSF	Sinking fund depreciation
90 UPSZONE	Finds UPS zones from zip code
91 ENVELOPE	Types envelope including return address
92 AUTOEXP	Automobile expense analysis
93 INSFILE	Insurance policy file
94 PAYROLL2	In memory payroll system
95 DILANAL	Dilution analysis
96 LOANAFDD	Loan amount a borrower can afford
97 RENTPRCH	Purchase price for rental property
98 SALELEAS	Sale-leaseback analysis
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57 PROFIND	Profitability index of a project
58 CAPI	Cap. Asset Pr. Model analysis of project

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## Four Implementations of Pascal

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The programming language Pascal was developed in the late 1960s and early 1970s by Niklaus Wirth. According to Wirth, principal aims were to create a language suitable for teaching and facilitating disciplined and systematic programming and to develop reliable and efficient implementations of the language on computers then available. Here, we review four implementations of Pascal designed for today's microcomputers. Three of these—Pascal/M, Pascal/MT+, and Pascal/Z—are designed to operate under the CP/M operating system; the fourth, Softech's UCSD Pascal, is an entire operating system designed to run on a variety of microcomputers, including Z80-based machines.

Wirth's Pascal, or standard Pascal, is defined in the *Pascal User Manual and Report* (K. Jensen and N. Wirth. New York: Springer Verlag, second edition, 1974) and is the common basis for the implementations considered. Each implementation is essentially a superset of this standard and incorporates features of the proposed International Standards Organization (ISO) draft proposal for the language, ISO/DP 7185. The ISO proposal extends Wirth's Pascal.

### Differences in Implementations

The four implementations of Pascal described here differ chiefly with respect to these kinds of features:

- Extensions to the ISO standards.

- Nature of code generated, whether machine code that can be directly executed in the target processor, or P-code (pseudo-machine code, also called intermediate code) that must be translated into machine code by an interpreter when the program is run.

- Types and variety of input and output primitives (intrinsic procedures for input and output).

- Support for separate compilation of modules or libraries of procedures and data structures (so that the separate modules can be called and used by other programs, eliminating the need to rewrite commonly used procedures).

- Support for memory overlays (an overlay is a section of code brought into main memory in an area previously occupied by another section of the same program). An overlay reduces the amount of main memory necessary for a program to run.

- Ease of use. The nature of the code generated and the steps required to generate it do much to determine ease of use.

We will describe each of the four implementations of Pascal and then examine the way they handle some of the Pascal features just mentioned. Some of the terms used to describe programming languages are defined separately in the text box "Programming Language Terms" on page 354.



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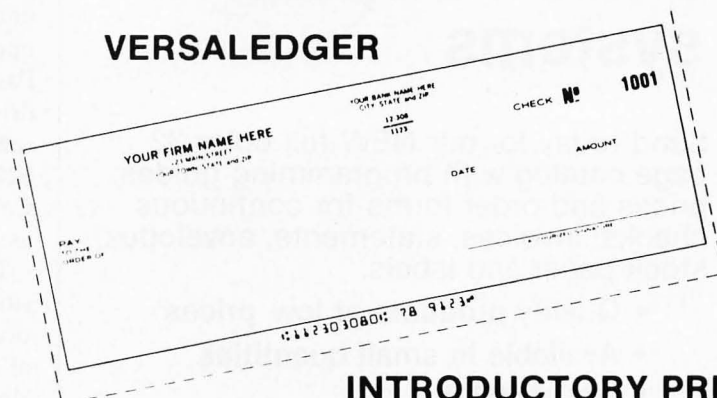
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## Pascal/Z

Ithaca Intersystems' Pascal/Z is a compiler for the Z80 processor and is designed to run under Digital Research's CP/M Version 2.2 operating system. Pascal/Z requires 56K bytes of RAM (random-access memory), including the space used by the operating system and at least one disk drive. According to the developer, the Pascal/Z compiler generates optimized macro-assembler code that is capable of being written into a read-only memory device (ROM-able) and capable of being interrupted and later reentered at the point of interruption (reentrant).

To execute a Pascal program with Pascal/Z, you must compile the source text, assemble the resulting Z80 assembler code, and link the resulting code file to a run-time library. The linked code is then ready for execution under CP/M.

The Pascal/Z compiler, assembler, and linker are all part of the Pascal/Z package, retailing for \$395.

## Pascal/M

The Pascal/M compiler, made by Sorcim of Santa Clara, California, is a one-pass compiler that produces a P-code file as output. Pascal/M was designed to run under CP/M 2.0, MP/M, Cromemco CDOS, and Oasis operating systems on Z80 or 8080/8085 machines. Pascal/M requires 56K bytes of memory and one disk drive. The Pascal/M package includes the compiler, a run-time library, and a run-time interpreter. It costs \$225. (Our thanks to Digital Marketing of Walnut Creek, California, for making a copy of Pascal/M available to us.)

Pascal/M is identical to UCSD Pascal—in all its extensions to standard Pascal—with two important exceptions. The similarity includes the naming and definition of strings and the built-in procedures for handling them, along with low-level, byte-oriented procedures for moving information from one part of memory to another.

The important differences between Pascal/M and UCSD Pascal are in the operating system and library facilities. Pascal/M operates under CP/M, but UCSD Pascal is an independent operating system. Pascal/M has no apparent facility for separate compilation of libraries of procedures; UCSD Pascal is well endowed in this regard. Pascal/M allows memory overlays.

## UCSD Pascal

UCSD Pascal, originally developed at the University of California, San Diego, is supplied by Softech Microsystems Inc. of San Diego. The UCSD Pascal system requires at least 48K bytes of contiguous RAM (64K bytes are recommended) and at least 175K bytes of disk storage.

UCSD Pascal comprises an entire operating system and can run on a variety of machines. The operating system includes a file handler, a character-oriented editor, a one-pass compiler that generates P-code, a conditional macro assembler, a linker, and a librarian utility. The operating



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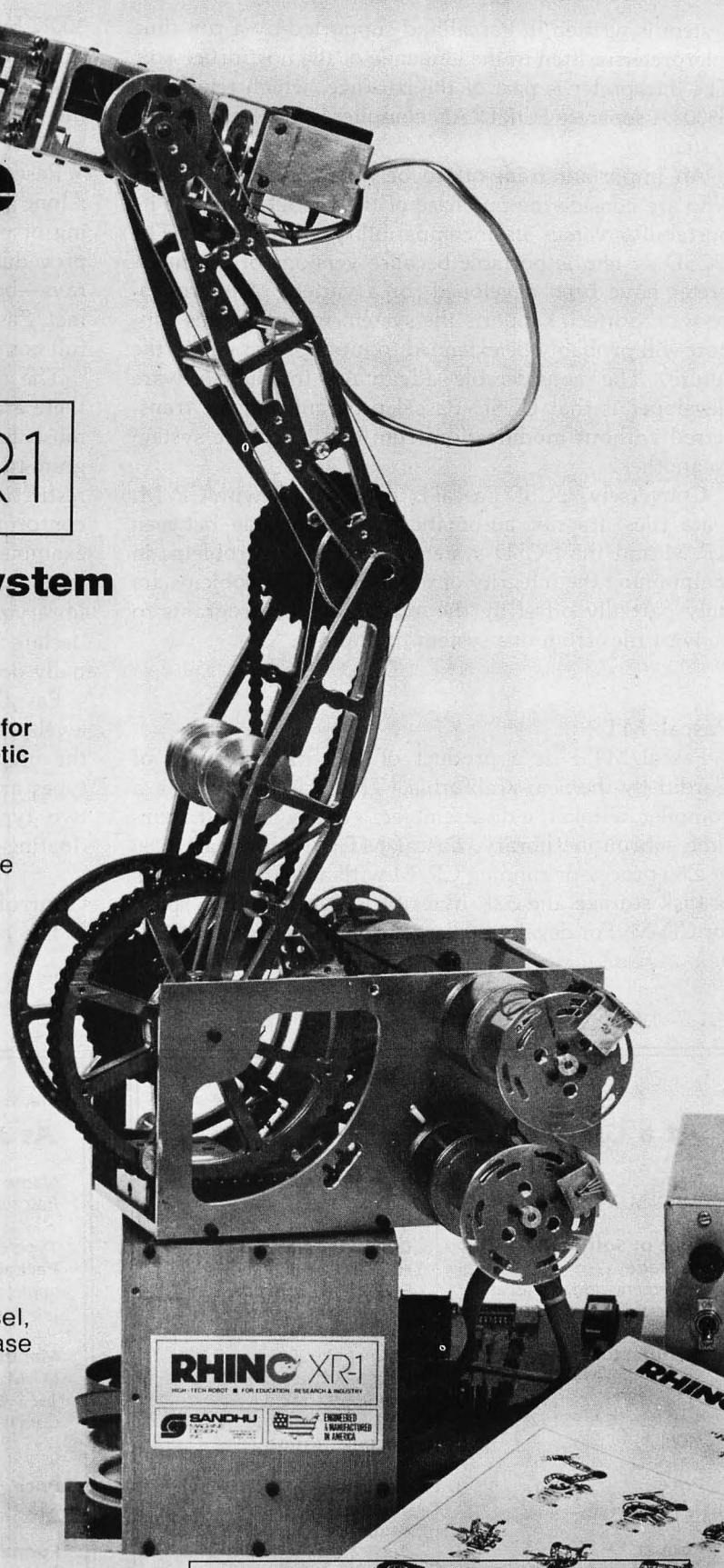
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system is written in Pascal and supported by a run-time interpreter written in the language of the host processor. The interpreter is part of the package, which retails for \$500. A separate FORTRAN compiler is available for the system.

An important trade-off to be noted by CP/M users who are considering purchase of the UCSD system is its portability versus its incompatibility with CP/M. The UCSD system is portable because versions of the interpreter have been developed for a variety of microprocessors. Softech supports the system well, and this support will probably be extended to more processors in the future. The considerable advantage to the software developer is that UCSD Pascal programs can be transferred without modification from one hardware system to another.

Conversely, UCSD Pascal is incompatible with CP/M. Data files are not automatically transferable between CP/M and the UCSD system. This causes problems in maintaining the integrity of databases. The problems are only partially offset by the availability of programs to convert files from one system to another.

### Pascal/MT+

Pascal/MT+ is a product of MT Microsystems of Cardiff-by-the-Sea, California. This Pascal includes a compiler, a linker, a disassembler, a debugger, and a run-time subroutine library. Pascal/MT+ requires an 8080 or Z80 processor running CP/M with at least 140K bytes of disk storage and 52K bytes of RAM, including space for CP/M. For developing large programs, a minimum of

300K bytes of disk storage and 60K bytes of RAM are suggested. The compiler generates relocatable, optimized Z80 code, or 8080 code (if desired) that must be linked to the run-time library. The Pascal/MT+ package costs \$450.

Pascal/MT+ is an interesting and powerful tool. Alone among the four implementations, it supports passing of procedures and functions as parameters to other procedures and functions and supports "conformant" arrays—both features required by the ISO standard. In fact, Pascal/MT+ is the only implementation that claims full compatibility with the ISO standard.

The conformant-arrays scheme is important because there are no dynamic arrays in Pascal. The programmer must change the declaration of an array in the source program to change the bounds of the array at run time. This restriction imposes a burden on the programmer. The conformant-array scheme provides greater flexibility. For example, you can pass bounds derived by the source program to a library program, provided the array in the library program is of the same type as the array originally declared and the bounds passed are within those originally declared.

Pascal/MT+ provides several facilities for machine-level programming from Pascal and also makes possible the use of interrupts. Also, several nonstandard data types are built in. For example, Pascal/MT+ provides two types of real data: fixed-point binary-coded and floating-point.

### Control Statements and Data Structures

The program control statements included in standard

### At a Glance

#### Name

Pascal/M, Version 3.3

supported by a run-time interpreter

#### Type of Software Package

Implementation of Pascal programming language

#### Manufacturer

Sorcim  
POB 32505  
San Jose, CA 95152  
(408) 248-5543

#### Computer Needed

Any Z80- or 8080/8085-based computer running either CP/M Version 1.4 or later, or MP/M, Cromemco CDOS or OASIS, with 56K bytes of RAM and one floppy-disk drive

#### Documentation

A 77-page, staple-bound manual

#### Price

\$225

#### Audience

Applications software developers, Pascal users

#### Format

8-inch standard CP/M floppy disk

#### Type of Compiler

Pseudo-code compiler

### At a Glance

#### Name

Pascal/MT+, Version 5.2

#### Type of Compiler

True Z80 compiler

#### Type of Software Package

Implementation of the Pascal programming language

#### Manufacturer

MT Microsystems  
1562 Kings Cross Dr.  
Cardiff-by-the-Sea, CA 92007  
(714) 755-1366

#### Computer Needed

Any Z80- or 8080-based computer running CP/M Version 2.2 with 52K bytes of RAM (56K or more preferred) and 140K of floppy-disk storage (300K preferred)

#### Documentation

A 165-page, staple-bound manual

#### Price

\$450

#### Audience

Applications software developers, Pascal users

#### Format

8-inch standard CP/M floppy disk



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## At a Glance

### Name

Pascal/Z, Version 3.3

### Type of Software Package

Implementation of Pascal programming language

### Manufacturer

Ithaca Intersystems Inc.  
1650 Hanshaw Rd.  
POB 91  
Ithaca, NY 14850  
(607) 257-0190

### Price

\$395

### Format

8-inch standard CP/M floppy disk

### Type of Compiler

True Z80 compiler

### Computer Needed

Any Z80-based computer running CP/M Version 2.2 with 54K bytes of RAM (64K preferred) and at least one disk drive (two drives preferred)

### Documentation

A 198-page, loose-leaf bound manual

### Audience

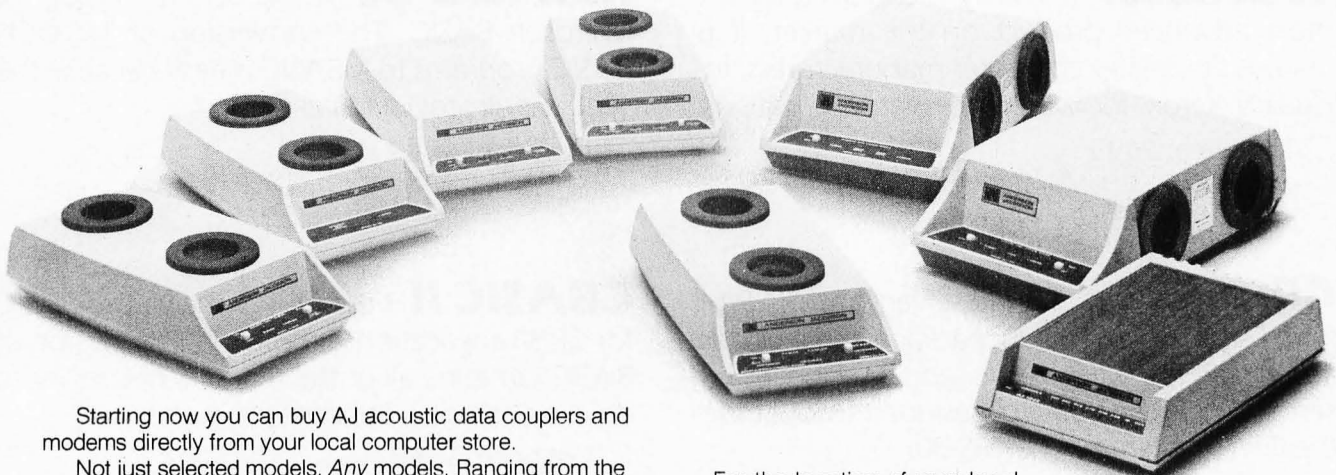
Applications software developers, Pascal users

Pascal are the WHILE...DO, REPEAT...UNTIL, IF...THEN...ELSE, the FOR...DO loop, the CASE statement, and the GOTO statement. All of these constructs are supported in the four implementations. All the implementations but UCSD Pascal have provided for an OTHERWISE clause in the CASE statement—an addition included in the ISO standard. A restricted form of GOTO (which precludes exiting the body of a procedure) is supported in all versions except Pascal/MT+, which provides unrestricted GOTOs.

The primitive data types defined in standard Pascal include integers, reals, Boolean data, user-defined scalars and subrange types, and character data. The defined, structured types include arrays, sets of scalars, pointers, record types, and files of records. Wirth's Pascal calls for text files and permits packing of structured types to conserve memory space.

All these data types and structuring techniques except packing are available in each of the four Pascals. Packing is not explicitly available in the native-code compilers Pascal/Z and Pascal/MT+. These two allocate memory in bytes, whereas the other two allocate in words; that is,

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the native-code compilers always pack data. Generally speaking then, the native-code compilers are more conservative in terms of memory needed for data than are the other two implementations, although similar and sometimes even greater conservation can be achieved by packing data in the other two.

All the versions extend standard Pascal to include a predefined string type. Strings of length N may be defined up to a maximum length of 255, and the actual length of a string may vary from 0 to N during program execution. The next section discusses built-in procedures for manipulating strings.

Pascal/M and UCSD Pascal have provided long (32-bit) integers as a predeclared data type. The operations permitted with long integers are addition, subtraction, and comparisons. Pascal/MT+ has provided two types of reals: floating-point reals and fixed-point, binary-coded decimal reals with 18 digits, four decimal. Pascal/Z provides floating-point reals and fixed-point reals with user-declared precision.

## Built-in Procedures and Functions

Standard Pascal includes a number of intrinsic procedures and functions, including transcendental-arithmetic functions, memory-management procedures, and several

## At a Glance

### Name

UCSD Pascal, Version 2.0

### Type of Software Package

Implementation of Pascal programming language, including the UCSD operating system

### Manufacturer

Softech Microsystems  
9494 Black Mountain Rd.  
San Diego, CA 92126  
(714) 578-6105

### Price

\$500. Note: price is for Version 4.0. We tested Version 2.0

### Format

8-inch IBM 3740-compatible disk

### Type of Compiler

Pseudo-code compiler supported by a run-time interpreter

### Computer Needed

Any Z80-, 8080/8085-, 6502-, or 6800-based computer with 48K bytes of con-

tiguous RAM (64K recommended) and a floppy-disk system with at least 175K bytes of online storage, or any Digital Equipment Corp. LSI-11 or PDP-11 computer

### Documentation

A 450-page, paper-bound manual; includes documentation for the UCSD operating system

### Audience

Applications software developers, Pascal users

### Comments

The UCSD system has its own file handler and operating system, including compiler, linker, assembler, editor, and librarian utility. When the system is used on machines already equipped with CP/M, only the BIOS routines from CP/M are used. Non-CP/M users will need to write their own simplified basic input/output subsystem (SBIOS) and bootstrap module. Documentation for how to write the SBIOS is included.



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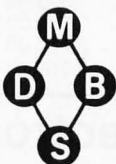
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input/output (I/O) procedures. We will consider the I/O procedures in a later section; for now, we will concentrate on other intrinsics and built-ins.

In standard Pascal you are permitted to dynamically allocate and deallocate memory for user-defined data types on a variable-by-variable basis. Only Pascal/MT+ fully implements this standard. In the other versions, you can allocate space on a variable-by-variable basis, but you can only deallocate blocks of memory cells at a time. In these cases, memory is a heap of undifferentiated cells; the programmer can mark the top of the heap, dynamically allocate memory to variables, and then deallocate memory back to the old top of the heap.

A useful function for dynamic-memory management is one that returns the amount of memory available at the time the function is called. Such a function can inform the programmer that allocating more memory may clobber some portion of the current program. All but Pascal/Z provide this function.

All the versions have provided built-in functions for manipulating the string types just described. Pascal/Z provides functions for appending one string to another, determining the length of a string, and finding the position of a substring within a string. The other versions have these three built-in functions, and functions for inserting, deleting, and copying substrings from a string.

UCSD Pascal, Pascal/MT+ and Pascal/M have provided several high-speed, built-in procedures for moving bytes between memory locations. You can move data between packed arrays of data and similar data structures, initialize packed arrays, and search arrays for specified bit patterns on a byte-by-byte basis.

Pascal/M, Pascal/MT+, and UCSD Pascal have a procedure called EXIT that permits clean exits from procedures, functions, and programs. A typical application would be to exit a program after flagging an egregious user error, such as bad input from the keyboard.

Pascal/M and UCSD Pascal support random screen-cursor addressing through the built-in function GOTOXY(X,Y). Pascal/M also has built-in procedures that permit homing the cursor, clearing to end of line, and so on. UCSD Pascal supplies the utility program SETUP that matches the operating system to the characteristics of the user's terminal.

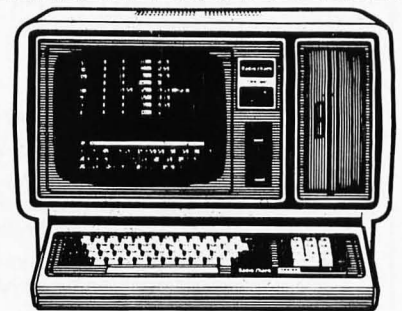
Pascal/MT+ has several built-in procedures and operators for byte and bit manipulation. For example, you can perform an "OR" operation on two integers that is a logical OR on their bit representations, and you can test bits, shift bits, and swap bytes in 16- and 8-bit variables. There are also built-in primitives for handling interrupts at the Pascal level. The programmer can enable and disable interrupts and designate up to seven Pascal proce-

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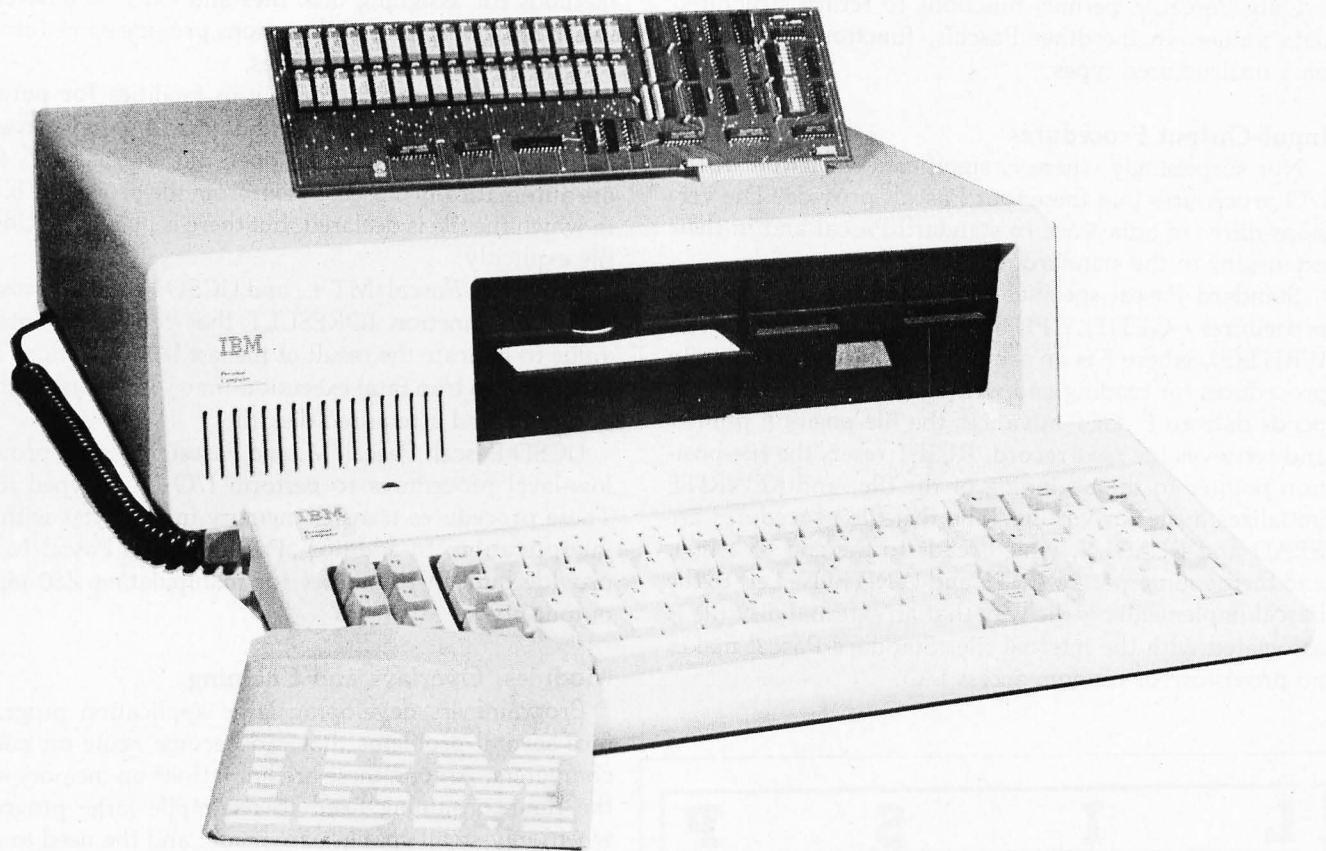
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dures as interrupt procedures. The programmer assigns a vector number to an interrupt procedure and the compiler generates code to load the vector number with the procedure address.

Only Pascal/Z permits functions to return structured data values. In the other Pascals, functions can return only unstructured types.

### Input-Output Procedures

Not surprisingly, there is significant variation in the I/O procedures that these four Pascals provide. The versions differ in adherence to standard Pascal and in their extensions to the standard.

Standard Pascal specifies four primitive file-handling procedures—GET(F), PUT(F), RESET(F), and REWRITE(F), where F is an arbitrary file type—and certain procedures for reading and writing text files. PUT(F) appends data to F, GET advances the file-position pointer and retrieves the next record, RESET resets the file-position pointer to the beginning of the file, and REWRITE initializes a file for writing. The text-file procedures are READ and READLN, which reads to the end of a line, and their counterparts WRITE and WRITELN. Left to the Pascal implementer is the way that an external disk file is associated with the internal file. Standard Pascal makes no provision for random access I/O.

Pascal/MT+, Pascal/M, and UCSD Pascal all supply the standard procedures; Pascal/Z subsumes the operations of GET and PUT under general-purpose READ and WRITE procedures. All four Pascals have simple methods for assigning disk files and external devices to internal file variables. All versions provide some form of random access for nontext files.

All four versions have built-in facilities for purging files from disk directories. All but Pascal/Z have an added procedure for closing an open file; in Pascal/Z, files are automatically closed on exit from the procedure block in which the file is declared, but there is no way to close a file explicitly.

Pascal/M, Pascal/MT+, and UCSD Pascal all provide a built-in function IORESULT that returns an integer value to indicate the result of the last I/O operation. The function can trap fatal execution-time I/O errors, such as failure to find a required disk file.

UCSD Pascal, Pascal/M, and Pascal/MT+ all provide low-level procedures to perform I/O on untyped files. These procedures transfer memory-image bytes with no interpretation. In addition, Pascal/M and Pascal/MT+ provide built-in primitives for manipulating Z80 input-output ports.

### Modules, Overlays and Chaining

Programmers developing large application programs face several problems that can become acute on microcomputers. Among these are limitations on memory size, the time-consuming need to recompile large programs when only small changes are made, and the need to link high-level programs to low-level routines for speed or convenience in special applications. The four Pascals reviewed here are reasonably well equipped with tools to solve these problems.

Two techniques for mitigating limitations on memory size are overlays (program segmentation) and chaining (calling one program from another). For the overlay approach, the programmer declares segments within a host program, with the segments either procedures or functions. A segment is brought into memory from disk when needed and remains active in memory only as long as needed; control returns to the host program. Segment procedures can access global data and procedures in the host program, just as they do ordinary procedures. With chaining, the currently active program calls the next link in the chain, which is then loaded from disk. There need be no host program per se and no relationship between the global declarations of chained programs.

UCSD Pascal and Pascal/M support overlays. In UCSD Pascal, a program can have a maximum of 16 segments, while Pascal/M can support as many as 10 segments. Both versions count the host program as one segment. Pascal/Z and Pascal/MT+ allow chaining. Both provide mechanisms for sharing global data between chained programs, but not for sharing global procedures. Pascal/Z, UCSD Pascal, and Pascal/MT+ support the ability to divide large programs into separately compil-

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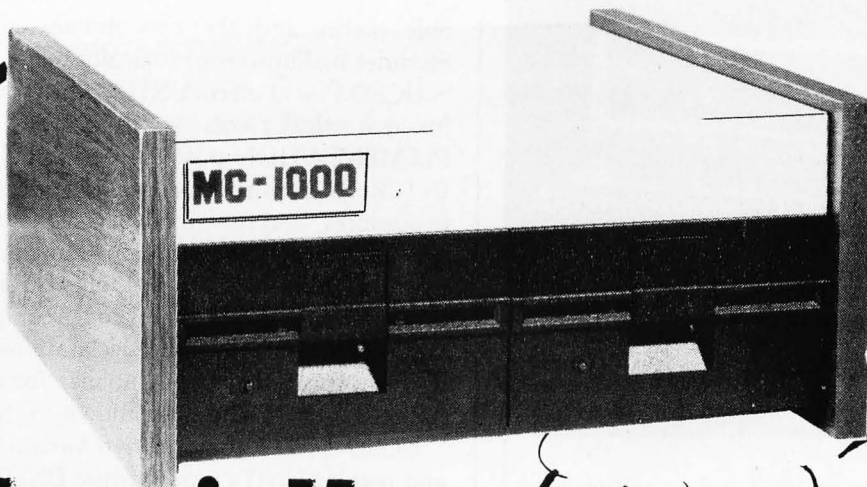
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able pieces and the concomitant ability to develop modules or libraries of logically related procedures.

UCSD Pascal offers UNITS, which consist of three major syntactical pieces: an INTERFACE portion, an IMPLEMENTATION portion, and initialization code. The INTERFACE portion contains the declarations (data, procedures, and functions) accessible to a host program. The IMPLEMENTATION portion contains the code for the procedures declared in the INTERFACE and any additional data structures and code required to perform the tasks of the unit; the latter declarations are not accessible to the host program. The initialization code is used to initialize the UNIT and is unknown to the host.

UCSD UNITS come in two varieties: intrinsic UNITS and regular UNITS. An intrinsic UNIT must be stored in the system library, which must be online when a program using the unit is executed. Intrinsic UNITS are prelinked to their hosts and do not have to be relinked if either the host or the UNIT is changed. Regular UNITS must be linked to the host by the programmer. Once linked, they need not be online, since the UNIT's code is duplicated in the host's code file. Regular UNITS count against the number of segments allowed in a program; intrinsic UNITS do not.

Pascal/MT+ provides what it calls modular compilation. When combined with a certain compiler option, this feature is comparable to the UCSD regular UNIT except for the initialization code. Pascal/MT+ modules may be somewhat more convenient to use than UCSD UNITS because the former can be broken into as many modules as desired at any time, while the latter require more forethought for effective use.

Pascal/Z provides a somewhat more limited version of modular compilation than Pascal/MT+. First, the number of modules is held to 10, including the host program. Also, there can be no hidden portions to a Pascal/Z module; in the language of UCSD UNITS, Pascal/Z modules consist of only an INTERFACE block. Finally, a Pascal/Z module cannot contain any global data declarations; it can only contain procedures and functions with local (private) data structures.

Like UCSD UNITS, Pascal/Z and Pascal/MT+ modules must be linked explicitly to their hosts. Unlike UCSD Pascal, Pascal/Z and Pascal/MT+ make the programmer responsible for insuring that data and procedures used by the host and its modules are declared consistently across modules.

Modules in Pascal/Z and Pascal/MT+ can freely use procedures declared in other modules. Procedures can be similarly cross-referenced by UCSD UNITS, but this requires more planning than in the other two Pascals.

Pascal/Z, Pascal/MT+ and UCSD Pascal all allow the user to link Z80 assembly-language programs to Pascal programs. Pascal/MT+ features a special declaration INLINE whereby the programmer can include hexadecimal code for machine-language programs in the body of a Pascal program without using externally assembled routines.



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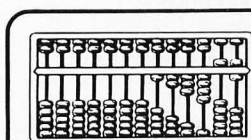
This menu driven program combined with **LETTER PERFECT** allows user to generate form letters and print mailing labels. With the Atari, you may **CONVERT ATARI DOS FILES**, or Visicalc files compatible for editing with **LETTER PERFECT**. Utility creates Data Base files for Letter Perfect.

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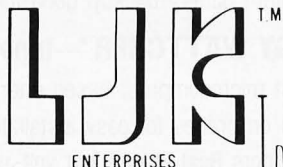
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p q r s t u v w x y z { | } ~

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## Ease of Use

Ease of use of any given language implementation lies mainly with the user. Ease of use may be defined as a measure of how quickly and reliably an implementation can help a programmer accomplish a given programming task.

The main advantage of Pascal is the ease with which the programmer can express the control and data structures that seem to arise naturally when designing a program. Beyond the standard Pascal, however, there is much that the language implementer can do to simplify the programmer's job. Since the programmer spends (or should spend) a great deal of time designing and writing programs, the relevant question is whether the language implementation helps or hinders the programming process. String functions, for example, have proved very useful in manipulating character data of arbitrary length, and all the Pascals we examined had string functions in one form or another. We feel that other additions to standard Pascal can be of great help, as long as they do not detract too much from the resulting program's portability to other systems. We previously discussed most of these useful features.

In addition to programming ease, there is debugging ease that reduces the time necessary for the programmer to sit in front of the video display. The sequence of com-

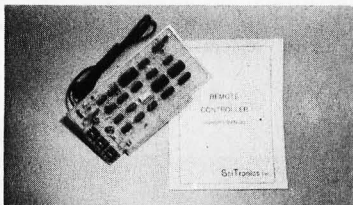
mands that the user types to compile, link, and run a program can be simple (e.g., with UCSD Pascal, in the simplest case, you can execute a source program just by typing an "R") or complex (e.g., Pascal/Z, which in the simplest case requires three separate CP/M commands to transform a source file into a runnable program). Fortunately, CP/M commands can themselves be gathered into a file and executed using the SUBMIT feature.

Finally, the documentation can be a source of either help or frustration. The manuals that accompany these packages are uniformly poor; unfortunately, they were probably written by the programmers who developed the packages. Any user who expects to learn Pascal from these will be bitterly disappointed. (Although to be fair, the manuals do not claim to be tutorials.) We also found the manuals disorganized, with poor indexes and tables of contents. Finding the answer to any specific question was a challenge, and the clarity of the English in the documentation is best left without critique.

We mentioned earlier that UCSD Pascal comprises an entire operating system, but failed to express the grief we experienced in getting the system configured for our machine, compounded by the confusing and contradictory documentation. The configuration process per se is simple. The difficulty is in reaching the point at which you can start the configuration process.

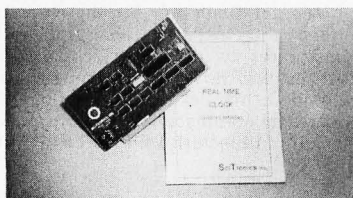
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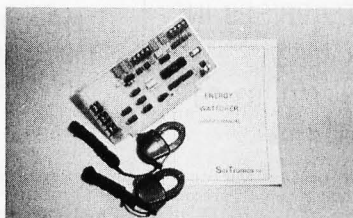
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We point this out not to dissuade the reader from using UCSD Pascal, but to inform you of what to expect. If you are interested in UCSD Pascal, it may be worthwhile to seek out a configuration matched to your machine. Some preconfigured versions are available.

## Benchmarks

To test each version of Pascal for speed, ease of use, and other features, we wrote and ran a series of benchmark programs. We did all testing on a Cromemco System III computer, which has 64K bytes of memory and two 8-inch floppy-disk drives capable of handling more than a million bytes of data each. The CP/M-compatible versions of Pascal were run under CP/M version 2.2 (from Intelligent Terminals Corporation). We timed the programs using Mountain Computer's 100,000 Day Clock. The results appear in table 1.

A few words of caution: the results of these (or any other) benchmarks should not be taken as absolute indicators of any Pascal's inherent quality. Our programs are necessarily simple and relatively portable between the

different implementations. We certainly do not represent these programs as the "best" programming solutions available for the problems they solve.

Our first benchmark, PRIMES (see listing 1), is a program to calculate the first 1000 prime numbers, using a method from Donald Knuth's *The Art of Computer Programming, Volume I: Fundamental Algorithms* (Reading, MA: Addison-Wesley, 1968), pages 143-144. The only statements that needed change, as we moved from one version of Pascal to the next, were in the routine to read the time from the Mountain Computer clock board, which required Z80 hardware port input. Pascal/M and Pascal/MT+ had intrinsic routines to do such input; for UCSD Pascal and Pascal/Z, we wrote small assembler routines to do the job. To minimize rewriting, we isolated the version-dependent code in a function that was different for each implementation.

We also made two ease-of-use measurements while we were compiling and running the program. First, we measured the time needed to transform the Pascal source file into a running program. For the CP/M Pascals, we used a SUBMIT file containing the necessary commands

Language Implementation Program	Pascal/M	Pascal/MT +	Pascal/Z	UCSD Pascal
<b>PRIMES</b>				
Execution time	94.2 sec	24.1 sec	35.1 sec	70.0 sec
"Compile time"	35 sec	93 sec	132 sec	46 sec
Keystrokes required to run	31	56	68	16
<b>PRECISION</b>				
Small	5.96E - 08	1.19E - 07	2.38E - 07	5.96E - 08
Big	3.36E + 07	1.68E + 07	8.39E + 06	3.36E + 07
<b>BLOWUP</b>				
Memory available for dynamic variables	37.4 K	52.3 K	52.4 K	38.9 K
<b>BENCHMARK</b>				
(All numbers are execution times in seconds)				
Random number generation	3.4	2.7	1.1	2.0
Writing array to disk	3.5	4.3	3.9	6.9
Shell sort	332	152	93	193
Reading array from disk	1.4	2.0	1.8	2.4
Quicksort	31	14	15	18
Binary tree generation	51	21	8	25
Writing tree to disk	28	25	21	45
Displaying array on CRT	46	10	14	22
Displaying tree on CRT	48	11	14	23

**Table 1:** Results of benchmarking programs for four implementations of Pascal. All testing was done on a Cromemco System III computer with two 8-inch disk drives. PRIMES, shown in listing 1, is a program that calculates the first 1000 prime numbers. PRECISION, shown in listing 2, determines the precision of floating-point calculations in each implementation of Pascal. BLOWUP, shown in listing 3, determines the approximate amount of memory space available for dynamically allocated variables. BENCHMARK, shown in listing 4, performs a series of tasks common in applications programs.



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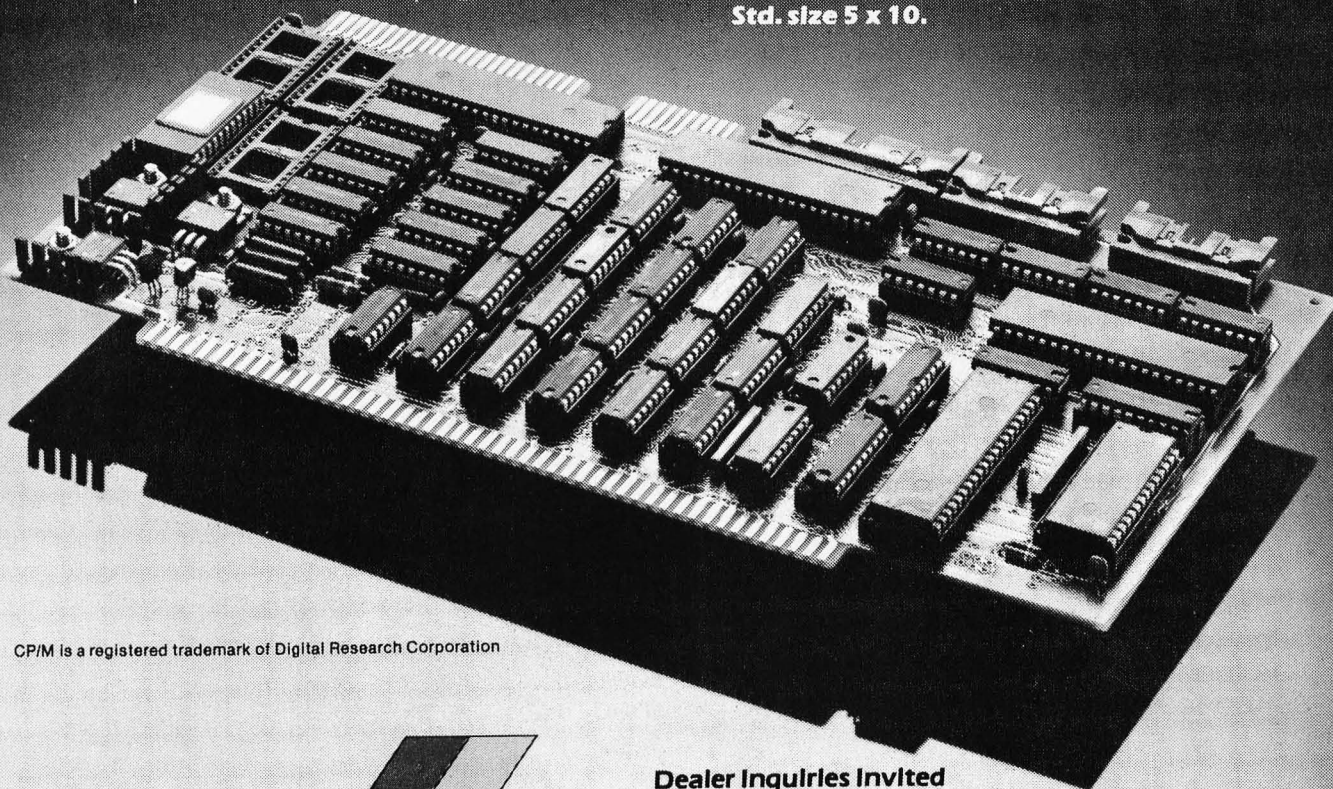
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**Listing 1:** PRIMES, a Pascal program that calculates the first 1000 prime numbers, based on an algorithm from Donald Knuth's *The Art of Computer Programming, Volume I: Fundamental Algorithms*.

```

PROGRAM Primes;
CONST
  maxvec=14; (* used by the timing routine *)
  np=1000; (* number of Primes *)
TYPE
  timevec=ARRAY[0..maxvec] OF INTEGER;
VAR
  Junk,lapse:REAL;
  t:timevec;
  Pr:ARRAY [1..np] OF INTEGER;
  J,k,n,a,r:INTEGER;

FUNCTION Portin(Port:INTEGER):INTEGER; (* Pascal-M version *)
VAR
  i:INTEGER;
BEGIN
  inPort(Port,i);
  Portin:=i;
END;

FUNCTION tick(VAR t:timevec):REAL;
CONST
  basePort=32;
VAR
  i:INTEGER;
  Prev:timevec;
BEGIN
  FOR i:=0 TO maxvec DO
    Prev[i]:=t[i];
  FOR i:=0 TO maxvec DO
    t[i]:=Portin(basePort+i);
  tick:=0.0001*(t[ 0]-Prev[ 0])+ (* 100 microseconds *)
        0.001*(t[ 1]-Prev[ 1])+ (* milliseconds *)
        0.01*(t[ 2]-Prev[ 2])+ (* 10 milliseconds *)
        0.1*(t[ 3]-Prev[ 3])+ (* 100 milliseconds *)
        1.0*(t[ 4]-Prev[ 4])+ (* seconds *)
        10.0*(t[ 5]-Prev[ 5])+ (* 10 seconds *)
        60.0*(t[ 6]-Prev[ 6])+ (* minutes *)
        600.0*(t[ 7]-Prev[ 7])+ (* 10 minutes *)
        3600.0*(t[ 8]-Prev[ 8])+ (* hours *)
        36000.0*(t[ 9]-Prev[ 9])+ (* 10 hours *)
        86400.0*(t[10]-Prev[10])+ (* days *)
        864000.0*(t[11]-Prev[11])+ (* 10 days *)
        8640000.0*(t[12]-Prev[12])+ (* 100 days *)
        86400000.0*(t[13]-Prev[13])+ (* 1000 days *)
        864000000.0*(t[14]-Prev[14])+ (* 10000 days *)
END;

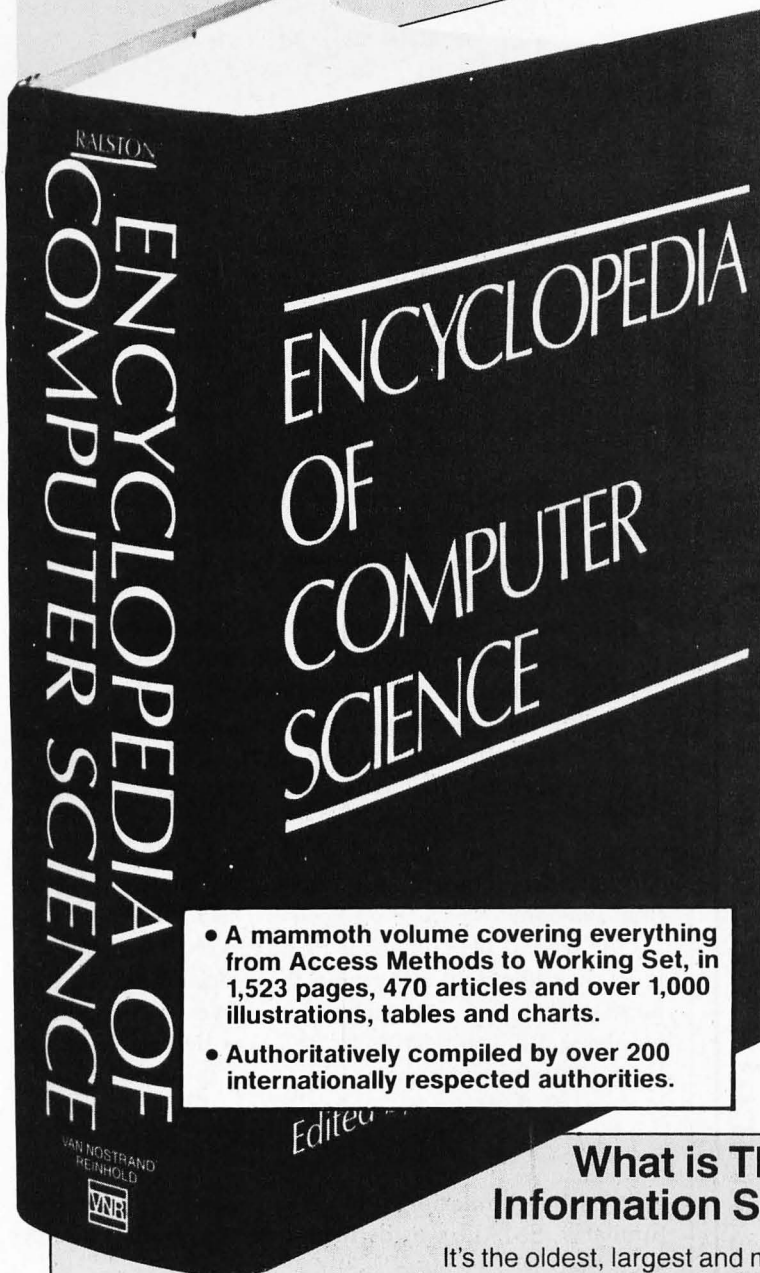
BEGIN
  writeln('The first ',np,' Primes:');
  Junk:=tick(t);
  Pr[1]:=2;
  Pr[2]:=3;

```

*Listing 1 continued on page 338*



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```

n:=3;
j:=2;
REPEAT
  REPEAT
    n:=n+2;
    k:=1;
    REPEAT
      k:=k+1;
      a:=n DIV Pr[k];
      r:=n-a*Pr[k];
    UNTIL (a<Pr[k]) OR (r=0);
  UNTIL r<>0;
  j:=j+1;
  Pr[j]:=n;
UNTIL j=nr;
lapse:=tick(t);
FOR j:=1 TO nr DO
  writeln('Prime(',j,')= ',Pr[j]);
writeln('The calculation took ',lapse,' seconds. ');
END.

```

to eliminate variation due to typing speed. We started timing when the compilation of the program began and

stopped when the program's message "The first 1000 primes:" was displayed. Then we counted the number of keystrokes that would have been necessary for compilation.

As expected, we found that the execution time of programs produced by the native-code compilers was much less than that of programs produced by the P-code compilers. On the other hand, the compilation time and the number of keystrokes necessary to run the program were much greater for the native-code compilers; there is a trade-off between calculational speed and ease of use. Perhaps the ideal situation would have P-code used for software development and native code employed for the final version.

Our second benchmark is PRECISION (see listing 2). It is an attempt to determine the precision of floating-point calculation for each Pascal. We calculated two numbers, BIG and SMALL. BIG was defined to be the largest number such that:

$$(BIG + 1.0) > BIG$$

given the limitations of floating-point arithmetic. Similarly, SMALL was defined to be the smallest number such that:

$$(1.0 + SMALL) > 1.0$$

Here we found that all our Pascals had approximately seven digits of precision, some slightly more and others slightly less. (Note that all four versions include some means of doing extended-precision arithmetic.)

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Unfortunately, the loops and tests and flags that work so well for a small program get out of control very rapidly as the program grows. Pretty soon, some of the things the program must do are not being done fast enough. The code gets too complicated, difficult to modify and unreliable. The result: another software failure!

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Listing 2: *PRECISION*, a program that determines the precision of floating-point calculations for each Pascal.

```
PROGRAM Precision;
VAR
  small, big, factor, test: REAL;
BEGIN
  small:=1.0;
  factor:=3.0;
  WHILE factor>(1.0+small) DO
    BEGIN
      test:=small/factor;
      WHILE ((test+1.0)>1.0) AND (test<small) DO
        BEGIN
          small:=test;
          test:=test/factor;
        END;
      factor:=(1.0+factor)/2.0;
    END;
  writeln('Small= ',small);

  big:=1.0;
  factor:=3.0;
  WHILE factor>(1.0+small) DO
    BEGIN
      test:=big*factor;
      WHILE ((test+1.0)>test) AND (big<test) DO
        BEGIN
          big:=test;
          test:=test*factor;
        END;
      factor:=(1.0+factor)/2.0;
    END;
  writeln('Big= ',big);
END.
```

Our third benchmark, BLOWUP (see listing 3), was designed to measure the amount of memory each implementation had available for dynamically allocated variables. The program successively allocates 100-byte blocks of memory until a run-time error occurs due to lack of additional memory. The program continuously prints out the number of blocks it has successfully allocated; the last number it prints (before the run-time error), divided by 10, is the approximate dynamic-memory space in kilobytes. All the versions of Pascal except for Pascal/MT+ generated such an error; running the program with Pascal/MT+ eventually caused the system to "hang," apparently due to overwriting the memory containing the program or the operating system. Pascal/MT+ does not check for such memory overflow; the programmer must do it with one of the built-in procedures. (For many programmers, this may be a desirable feature.)

From this program we found that the native-code compilers have more space for program code and dynamic variables than do the P-code versions. This is probably

because of the extra memory required for the P-code interpreters, which results in less memory available to user programs. This test is somewhat misleading, however, since for larger programs this situation could be reversed. P-code should be more compact than native code, and the compactness should atone for the interpreter overhead in large programs. (We did not test this hypothesis.)

The final benchmark is called BENCHMARK (see listing 4), which is an attempt to measure the different Pascals' performances in the more realistic applications of sorting, disk I/O, and data-structure generation. The program first generates a pseudorandom array of 1024 integers, then writes it to disk. (Pascal allows writing the entire array as a single entity, which turns out to be infinitely faster on our system than writing each element of the array individually.) The array is sorted using the Shell-Metzner algorithm. The random array is then read back into memory from disk (again, as a single entity) and sorted using the quicksort algorithm. (Both sorting algorithms are adapted from *Algorithms Plus Data Struc-*

*Text continued on page 352*



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**Listing 3:** *BLOWUP*, a program that measures the amount of memory available for dynamically allocated variables. The program successively allocates 100-byte blocks of memory until a run-time error occurs.

```

PROGRAM blowup;
CONST
  blocksize=100;
TYPE
  byte=0..255;
  block=PACKED ARRAY[1..blocksize] OF byte;
  blockptr=^block;
VAR
  p: blockptr;
  i, j: INTEGER;
BEGIN
  i:=0;
  WHILE TRUE DO
    BEGIN
      new(p);
      FOR j:=1 TO blocksize DO
        p[j]:=0;
      i:=i+1;
      writeln(i);
    END;
  END.

```

**Listing 4:** *BENCHMARK*, a program that measures performance in tasks that occur commonly in applications programs. The program generates a random array of integers; writes the array to disk; sorts the array with the Shell-Metzner algorithm; reads the random array back into memory from disk; sorts the array with the quicksort algorithm; reads the unsorted array into memory yet again, using the integers as keys by which dummy data are stored in a binary tree; and writes the tree elements individually to disk. Along the way, the program displays the array elements on the terminal screen to insure that the disk input/output and the sorts are done correctly, as well as to see how fast each version of Pascal can output text.

```

PROGRAM benchmarks;

CONST
  maxlen=1024;
  maxvec=14; (* part of timing package *)

TYPE
  index=0..maxlen;
  vector=ARRAY[index] OF INTEGER;
  link=^node;
  dummydata=RECORD
    key: INTEGER;
    frequency: index;
    datafield: STRING[16];
  END;
  node=RECORD
    dd: dummydata;
    left, right: link;
  END;
  timevec=ARRAY[0..maxvec] OF INTEGER; part of timing package

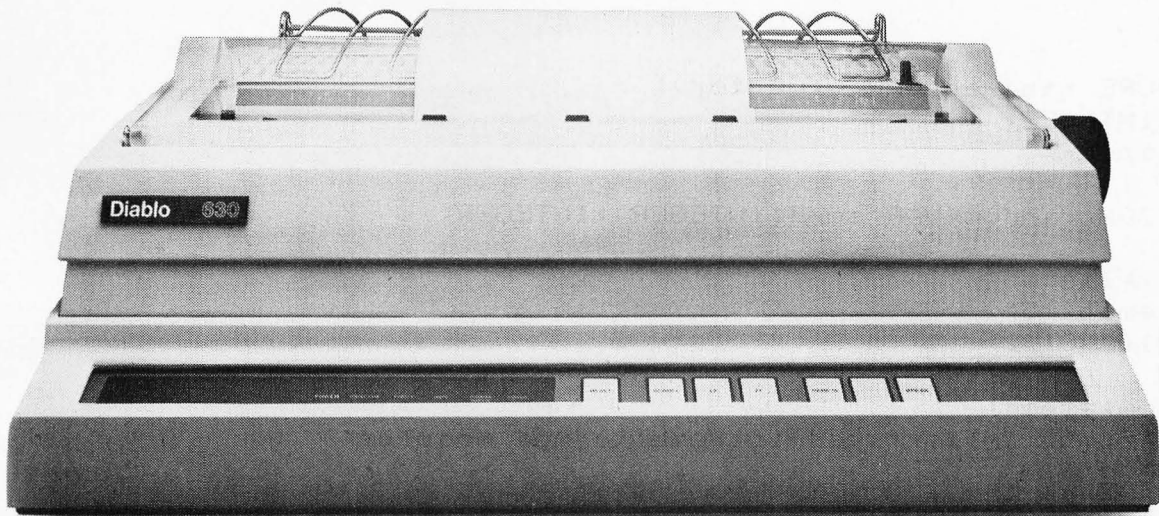
VAR
  v: vector;
  root: link;
  nodecount: INTEGER;

```

Listing 4 continued on page 344



# If you want a choice in print wheels, here's the first choice in printers.



The Diablo 630.

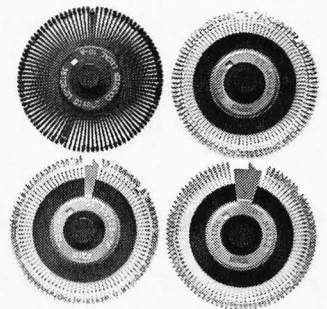
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Circle 129 on inquiry card.

BYTE March 1982 343



*Listing 4 continued:*

```
Junk:REAL; part of timing package
t:timevec

(* define 'Portin' and 'tick' as in PROGRAM Primes: *)

FUNCTION Portin(Port:INTEGER):INTEGER;
BEGIN
...
...
END;

FUNCTION tick(VAR t:timevec):REAL;
BEGIN
...
...
END;

PROCEDURE randgen(VAR v:vector);
VAR s:INTEGER;
    i:index;

FUNCTION random(VAR seed:INTEGER):INTEGER;
CONST
    multiplier=3;
    increment=5;
    modulus=8192;
BEGIN
    random:=seed;
    seed:=(multiplier*seed+increment) mod modulus;
END;

BEGIN (* randgen *)
    s:=3;
    FOR i:=1 TO maxlength DO
        v[i]:=random(s);
    END;
END;

PROCEDURE writearray(VAR v:vector);
VAR
    f:FILE OF vector;
BEGIN
    rewrite(f,'vector.dat');
    f^:=v;
    put(f);
    close(f,lock);
END;

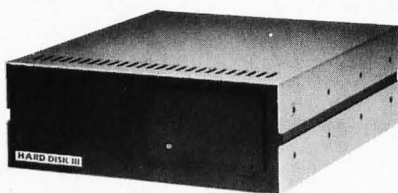
PROCEDURE readarray(VAR v:vector);
VAR
    f:FILE OF vector;
BEGIN
    reset(f,'vector.dat');
    get(f);
    v:=f^;
END;
```

*Listing 4 continued on page 346*



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```

PROCEDURE shellsort(VAR v:vector);
VAR jump,m,n:index;
    temp:INTEGER;
    done:BOOLEAN;
BEGIN
    jump:=maxlength;
    WHILE jump>1 DO
    BEGIN
        jump:=jump DIV 2;
        REPEAT
            done:=TRUE;
            FOR m:=1 TO (maxlength-jump) DO
            BEGIN
                n:=m+jump;
                IF v[m]>v[n] THEN
                BEGIN
                    temp:=v[m];
                    v[m]:=v[n];
                    v[n]:=temp;
                    done:=FALSE;
                END;
            END;(* FOR *)
        UNTIL done;
    END;(* WHILE *)
END;(* shellsort *)

PROCEDURE quicksort(VAR v:vector);

PROCEDURE sort(left,right:index);
VAR i,j:index;
    pivot,temp:INTEGER;
BEGIN
    i:=left;j:=right;
    pivot:=v[(left+right) DIV 2];
    REPEAT
        WHILE v[i]<pivot DO i:=i+1;
        WHILE pivot<v[j] DO j:=j-1;
        IF i<=j THEN
        BEGIN
            temp:=v[i];
            v[i]:=v[j];
            v[j]:=temp;
            i:=i+1;
            j:=j-1;
        END;
    UNTIL i>j;
    IF left<j THEN sort(left,j);
    IF i<right THEN sort(i,right);
END;

BEGIN
    sort(1,maxlength);
END;

```

Listing 4 continued on page 348

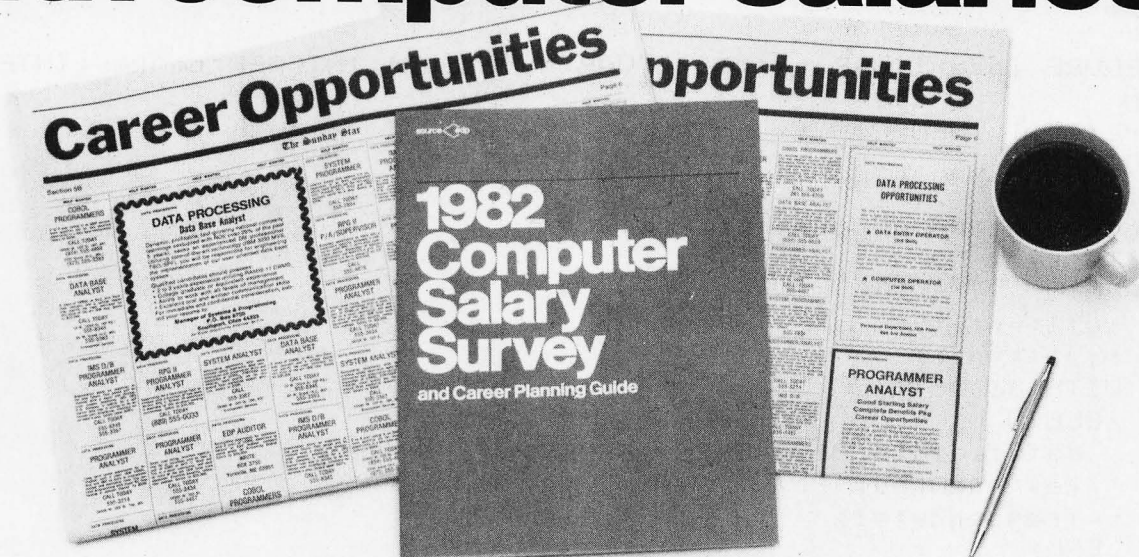
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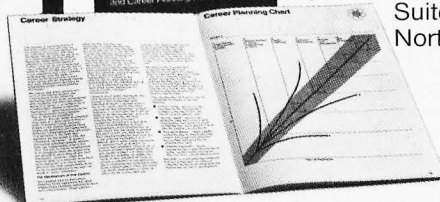
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```

PROCEDURE treesen(VAR root:link;VAR v:vector);
VAR
  nodecount:INTEGER;
  i:index;

PROCEDURE insert(VAR ref:link;VAR nodecount:INTEGER;newkey:INTEGER);
BEGIN
  IF ref=nil THEN
    BEGIN
      new(ref);
      nodecount:=nodecount+1;
      WITH ref^ DO
        BEGIN
          left:=nil;
          right:=nil;
          WITH dd DO
            BEGIN
              datafield:='0123456789ABCDEF';
              key:=newkey;
              frequency:=1;
            END;
          END;
        END;
      ELSE WITH ref^ DO
        IF newkey<dd.key THEN insert(left,nodecount,newkey)
        ELSE IF newkey>dd.key THEN insert(right,nodecount,newkey)
        ELSE (*duplicate key! update frequency.*)
          dd.frequency:=dd.frequency+1;
        END;
      END;
    BEGIN
      root:=nil;
      nodecount:=0;
      i:=0;
      REPEAT
        i:=i+1;
        insert(root,nodecount,v[i]);
      UNTIL i=maxlength;
      writeln(nodecount,' distinct nodes created. ');
    END;

PROCEDURE writetree(root:link);
VAR
  dummyfile:FILE OF dummydata;
  counter:INTEGER;

PROCEDURE traverse(ref:link;VAR counter:INTEGER);
BEGIN
  IF ref<>nil THEN
    BEGIN
      traverse(ref^.left,counter);
      dummyfile^:=ref^.dd;
      put(dummyfile);
    END;
  END;

```



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Listing 4 continued:

```
        counter:=counter+1;
        traverse(ref^.right, counter);
    END;
END;

BEGIN
    rewrite(dummyfile, 'dummy.dat');
    counter:=0;
    traverse(root, counter);
    close(dummyfile, lock);
    writeln(counter, ' records written. ');
END;

PROCEDURE disparray(VAR v:vector);
VAR
    i:index;
BEGIN
    FOR i:=1 TO maxlenath DO writeln(v[i]);
END;

PROCEDURE disetree(ptr:link);
BEGIN
    IF ptr<>nil THEN BEGIN
        disetree(ptr^.left);
        writeln(ptr^.dd.key);
        disetree(ptr^.right);
    END;
END;

BEGIN
    Junk:=tick(t);

    randgen(v);
    writeln('Random array generation took ', tick(t), ' sec. ');

    disparray(v);
    writeln('Displaying array took ', tick(t), ' sec. ');

    writearray(v);
    writeln('Writing array to disk took ', tick(t), ' sec. ');

    shellsort(v);
    writeln('Shell sort took ', tick(t), ' sec. ');

    disparray(v);
    writeln('Displaying array took ', tick(t), ' sec. ');

    readarray(v);
    writeln('Reading array from disk took ', tick(t), ' sec. ');

    disparray(v);
    writeln('Displaying array took ', tick(t), ' sec. ');

    quicksort(v);
    writeln('Quicksort took ', tick(t), ' sec. ');
```

Listing 4 continued on page 352



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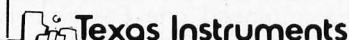
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Listing 4 continued:

```
displayarray(v):
writeln('Displaying array took ', tick(t), ' sec. ');

readarray(v):
writeln('Reading array from disk took ', tick(t), ' sec. ');

displayarray(v):
writeln('Displaying array took ', tick(t), ' sec. ');

treegen(root, v):
writeln('Generating binary tree took ', tick(t), ' sec. ');

disptree(root):
writeln('Displaying tree took ', tick(t), ' sec. ');

writetree(root):
writeln('Writing tree to disk took ', tick(t), ' sec. ');

END.
```

Text continued from page 340:

tures Equals Programs by Niklaus Wirth, Prentice-Hall, 1975.) After this, the unsorted array is again read into memory, and the integers are used as keys by which dummy data are stored in a binary tree. The tree elements are then written individually to disk. The array elements are displayed on the monitor along the way to insure that the disk I/O and the sorting are done correctly. Displaying the array also measures how fast the Pascal can output textual information.

The incompatibilities between the Pascal implementations for this program only involved the way the disk data were accessed. Slight changes in the program were made for opening, closing, reading, and writing to the disk files. (Obviously, the changes described for reading the clock also had to be made.)

Again, native-code compilers were faster in the computation-intensive tasks such as sorting and were also noticeably faster in output to the terminal. All Pascals took about the same time to write and read from the disk.

The four Pascals reviewed here defy classification as good or bad; they seem almost to represent different philosophies of language implementation. We cannot recommend one Pascal over another or say that you would find any of them unacceptable for your purposes. We only hope that you now have enough information to decide for yourself. ■

Updates seem to be published faster than magazines are. Some information on new versions of the Pascals tested in this article is given on page 356. . . . G.W.

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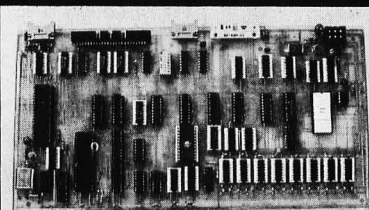


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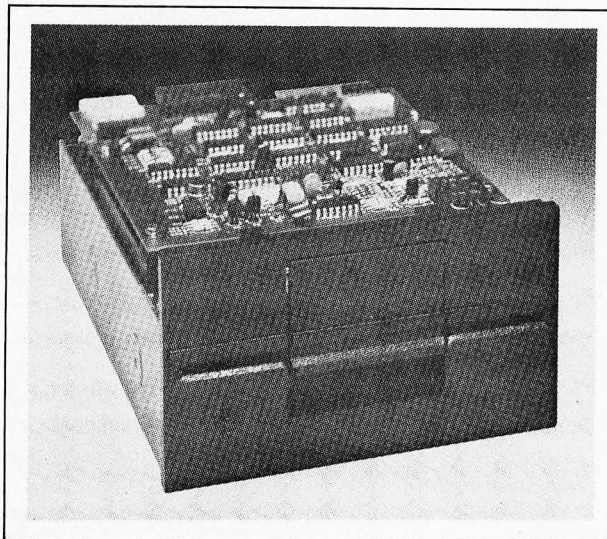
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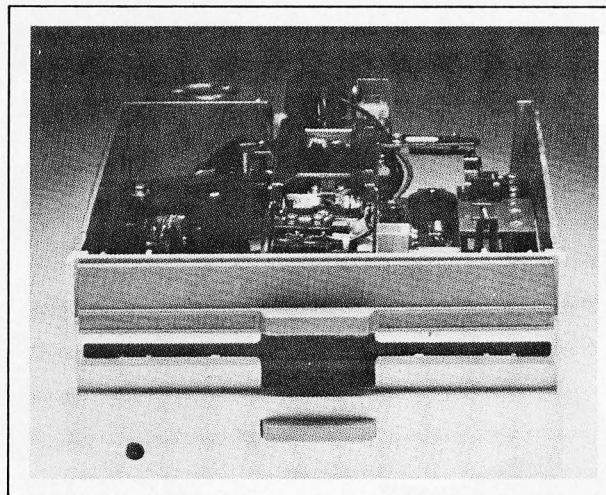
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## Programming Language Terms

Machine language, also called object code, is binary; it consists entirely of zeros and ones. Words made of zeros and ones represent both op codes, which define basic operations in the processor, and addresses of the data on which an operation is to be performed. The accurate reading and writing of machine language is difficult.

Machine-language statements that use the correct op codes for a specific processor are said to be the native code for that processor.

Intermediate between machine language and higher-level languages like Pascal is assembly language. Assembly language substitutes standard mnemonics—more easily remembered names—for machine-language instructions. Statements in assembly language are not directly executable. An assembler is a program that translates assembly-language code into machine code; a macro assembler allows the programmer to use a single name to represent a sequence of assembly-language instructions. Assembly-language mnemonics vary from one processor to the next, and an assembly-language program written for one processor will not run on another.

A compiler is a program that translates the programmer's statement in a source language or higher-level language (such as BASIC or Pascal) into machine language. The resulting machine-language code needs no support software to run (except an operating system). Compilers process an entire program at one time; the resulting machine-language code can be executed only after the whole program is compiled.

Single-pass compilers complete the translation of a program in source language into machine language in a single, continuous operation. Multiple-pass compilers divide the process of translation into different stages. The advantage of multiple-pass compilers is that they usually reduce demands on main memory, though single-pass compilers work faster.

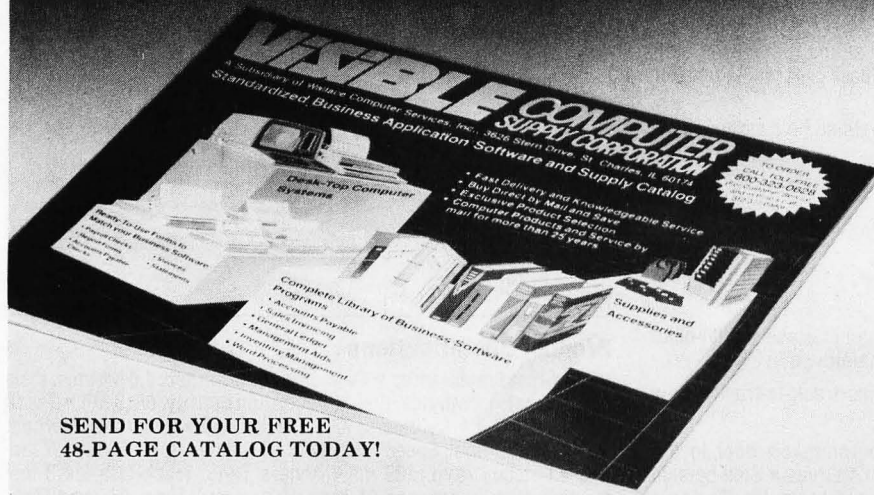
An interpreter is a program that translates each source-language statement into machine language as the statement is read and then immediately executes the machine-language translation of the statement.

Some higher-level language implementations such as CBASIC (from Compiler Systems) and Pascal/M compromise between the compiler approach and the interpreter approach. These implementations compile source code into a nonexecutable intermediate code; a separate interpreter must then be run to execute the intermediate code. The intermediate code produced by a Pascal compiler is called P-code. Unlike assembly language, P-code is the same for different versions of Pascal that use the intermediate-code approach.

A linker is a program that combines into a single module two or more program segments that have been separately compiled.

A program library is a set of programs distributed with a program language to provide code to perform frequently used operations. Programmers save time and labor by incorporating code from the library in programs under development. A linker can incorporate library program segments into a program whose other segments were written by an applications programmer and separately compiled.

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## Pascal Updates

Each Pascal has been revised and improved in the past few months. All of the vendors claim bug fixes, increased speed for low-level support routines, and better user interfaces. We were unable to test the new versions. Version numbers and prices were current as of October 1981.

### Pascal/Z Version 4.0

An interactive debugger and the ability to segment programs are the major additions to Pascal/Z. The debugger is fully symbolic. Among other things, you can symbolically display and modify local and global variables (including record fields), trace program flow, and display run-time memory requirements.

Overlays, or segments, are compiled separately like modules. They are then processed by a system program that prepares the memory maps and relocation information needed by a host that uses the overlay. Finally, they are linked to the host.

Version 4.0 costs \$395. The cost of updating from Version 3.3 is \$50; new manuals are included in the update.

### Pascal/M Version 4.02

Major enhancements to Pascal/M are an interactive symbolic debugger, the ability to perform 14-digit BCD arithmetic, and an increase from 10 to 40 in the number of program segments permitted.

### Pascal/MT+ Version 5.5

Several changes have been made to Pascal/MT+ to increase its power and compatibility with other CP/M software. The compiler has been reduced in size by 7K bytes, substantially adding to the amount of symbol table space for compiling user programs. Users can compile larger programs than were heretofore possible.

A converter program has been added to the collection of utility programs. The new program converts code files produced by the compiler to a format acceptable to Microsoft linkers. Overlays are now allowed. A program is permitted 16 overlay "areas" with up to 16 overlays per area. The programmer is burdened with supplying code address information to the linker before the overlays can be used by a host program.

The new version can be purchased with a speed programming kit that consists of a menu-driven program whose op-

tions include a screen-oriented character editor, a Pascal syntax scanner for preprocessing program texts, and an identifier frequency counter. The latter can be used, for example, to spot identifiers referenced only once in a program, such as uncalled procedures or unreferenced variables.

The manuals have been rewritten with improved indexes. Version 5.5, including the speed programming kit, is \$475.

### UCSD Pascal Version 4.0

(Note: Version 3.0 is specially designed for Western Digital's Microengine.)

Major enhancements to UCSD Pascal include an increase in the number of segments and units allowed to 255 and easier compilation and cross-referencing of units, facilitating the development of very large application programs. Programmers can also control the residency of segments and units in memory through calls to intrinsic procedures. Overlay segments can be protected from being overwritten by other segments until the programmer permits, and potentially time-consuming, annoying disk I/O (due to repeated calls to a segment) can be defeated. Chaining is also permitted in Version 4.0.

Procedures for memory management have also been augmented. One of these permits a form of dynamic arrays and should considerably increase the ease of development for libraries of procedures operating on arrays.

Concurrent processes have been implemented in Version 4.0. Concurrent processes, or tasks, are controlled by "semaphores" (a term coined by E. W. Dijkstra), which synchronize tasks and control access to critical code sections and resources. Semaphores can be associated with hardware interrupts so that interrupt handlers can now be written in UCSD Pascal.

Intrinsic procedures for redirecting program and system I/O have been included. Redirection of system I/O means that the system can be driven from a script in a manner similar to CP/M's SUBMIT facility. Redirection of program I/O enables the programmer to collect the input to (or output from) a program from any peripheral device or disk file.

Additions to the system's utilities include an interactive debugger, a procedural cross-referencer, and a console screen control unit. The documentation has also been completely rewritten.

Version 4.0 costs \$500. Preconfigured versions are available for a variety of machines.

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### At a Glance

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BASIC Compiler

**Type**

A BASIC compiler package, including a compiler, linker, routine library file, and run-time package

**Manufacturer**

Microsoft Consumer Products  
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**Price**

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**Format**

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**Language**

Z80 machine language

**Computer needed**

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**Documentation**

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**Audience**

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Machine and assembly languages are essential when you need fast execution that can't be accomplished with a higher-level language. Structured languages like Ada and Pascal make it much easier to monitor long, convoluted programs.

But we should listen carefully to the traditionalists; they probably learned to program on an IBM 650 in 1956 and have sage minds. Most of them will tell you that FORTRAN, COBOL, and the like are superior because they are compiled languages that use a computer much more efficiently. They forget that BASIC—originally written at Dartmouth College as a simple beginner's language for easy interaction with the computer—is now at least as sophisticated and as easily compiled as older languages.



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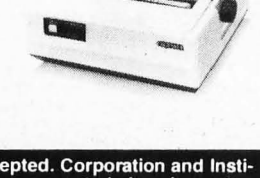
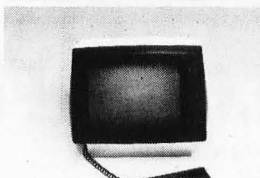
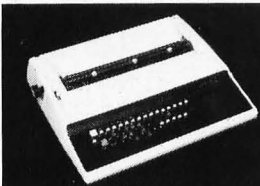
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Listing 1: A small BASIC program used to demonstrate the  
compiler.

```
10 DEFSNG A-Z
20 FOR I=1 TO 2000
30 A=I+2
40 NEXT I
50 PRINT CHR$(7)
```

## What It Does

A compiler is a machine-language program that trans-  
lates a higher-level language, such as FORTRAN or  
BASIC, into machine code. This compiled program can  
be stored on disk and run as if originally written in  
machine language. On the other hand, an interpreter,  
used in many microcomputers with BASIC, "translates"  
each line of a program while the program is running. If a  
line is executed many times, it must be "translated" many  
times.

A compiled program is therefore much faster than an  
interpreted one and uses the computer more efficiently  
despite the lengthy compilation time (which need only be  
done once). Compilation also allows more flexibility and  
offers options unavailable with interpretation. Converse-  
ly, an interpreted program can be run immediately,  
without waiting for compilation, and thus is much easier  
to debug, edit, and modify. Although this may be a poor  
practice, it is a good way to learn programming and is  
usually necessary to refine a moderately long program.

Microsoft's BASIC compiler gives you the best of both  
worlds. It is now possible to debug and modify a pro-  
gram using the TRS-80's built-in interpreter. Then, when  
it's doing just what you want, it compiles the program to  
get rapid execution.

I've often wished I could do that with FORTRAN on  
our university's Cyber 172; in fact, I have been known to  
write and rewrite a program in interpreted BASIC until it  
did what I wanted, then translate it "by hand" into  
FORTRAN for fast execution.

We can evaluate the Microsoft compiler in five ways:  
ease of use (and quality of documentation); compatibility  
with TRS-80 disk BASIC; speed; added features com-  
pared to interpreted BASIC; and any special quirks,  
bugs, or problems that may get in the way.

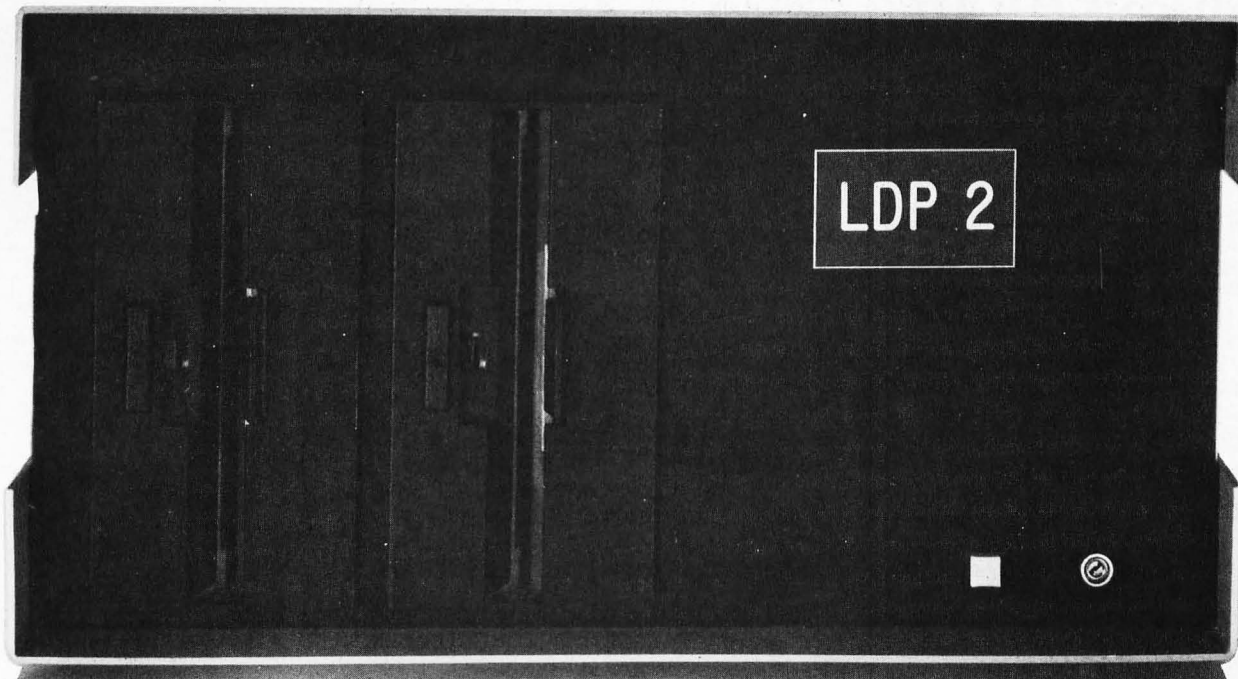
This compiler has many versions; the one I review here  
is the latest available for the TRS-80. It is much improved  
over that machine's first version, and anyone with the  
earlier version can obtain an update from Microsoft for a  
nominal charge.

## Procedures for Use

The compiler is very easy to use, although that's not  
conveyed in Microsoft's documentation. The compiler is  
really a package of four software modules: the actual  
compiler (BASCOM/CMD); a library file (BASLIB/REL); a linker (L80/CMD) that links machine  
code from the library file to the program as compiled by  
BASCOM; and a "run-time package" (BRUN/CMD)



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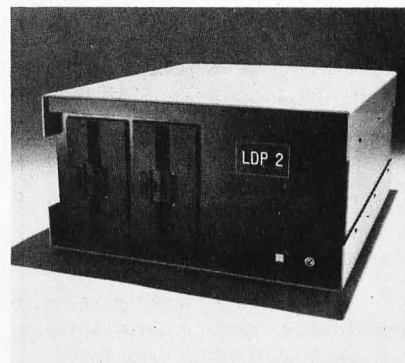
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### Listing 2: The compiled version of the program shown in listing 1.

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```

0014 0007      10 DEFSNG A-Z
      **      0014'      CALL $4.0
      **      0017'L00010:

0017 0007      20 FOR I=1 TO 2000
      **      0017'L00020:      CALL $FASA
      **      001A'      DW      I1
      **      001C'      DW      ,CONST.
      **      001E'I00000:

001E 000B      30 A=I+2
      **      001E'L00030:      CALL $FADA
      **      0021'      DW      I1
      **      0023'      DW      ,CONST.
      **      0025'      CALL $FASO
      **      0028'      DW      A1

002A 000F      40 NEXT I
      **      002A'L00040:      CALL $FADA
      **      002D'      DW      I1
      **      002F'      DW      ,CONST.
      **      0031'      CALL $FASO
      **      0034'      DW      I1
      **      0036'      CALL $LEJA
      **      0039'      DW      I1
      **      003B'      DW      ,CONST.
      **      003D'      DW      I00000

003F 000F      50 PRINT CHR$(7)
      **      003F'L00050:      CALL $PR0A
      **      0042'      LD      HL,0007
      **      0045'      CALL $CHR
      **      0048'      CALL $PV2D

004B 000F
      **      004B'      CALL $END

005C 0019

00000 FATAL ERROR(S)

08219 BYTES FREE

```

### Listing 3: The same compiled version of the program, except with two errors inserted to show the response of the compiler.

BASCOM 5.23 - COPYRIGHT 1979, 80 (C) BY MICROSOFT - 13512 BYTES FREE

```

0014 0007      10 DEFSNG A-Z
      **      0014'      CALL $4.0
      **      0017'L00010:

0017 0007      20 FOR I=1 TO 2000
      **      0017'L00020:      CALL $FASA
      **      001A'      DW      I1
      **      001C'      DW      ,CONST.
      **      001E'I00000:

001E 000B      30 A=I+2
      **      001E'L00030:      CALL $FADA
      **      0021'      DW      I1
      **      0023'      DW      ,CONST.
      **      0025'      CALL $FASO
      **      0028'      DW      A1

002A 000F      40 NXT I
      **      002A'L00040:

error pointer, syntax error SN

```

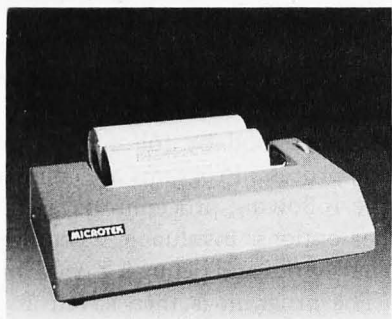
Listing 3 continued on page 364



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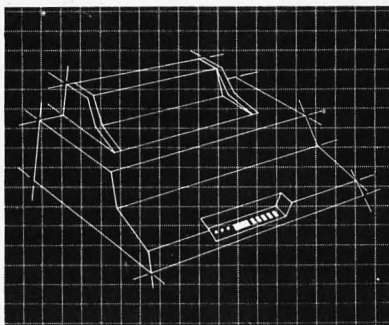
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\*Data Source: Epson MX-80 Operation Manual

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## TekWriter-2



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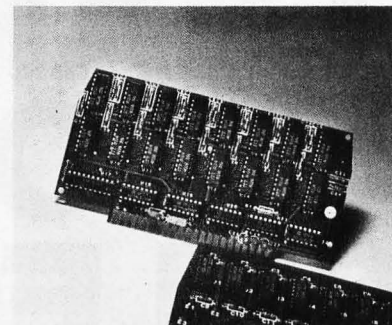
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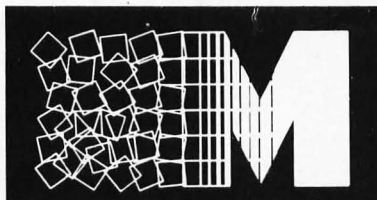
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Saddlebrook, NJ	March 1	Phoenix, AZ	March 23
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Listing 3 continued:

```

002A 000F          50 PRINT CHR$(7)
      **          002A'L00050:  CALL  $PROA
      **          002D'         LD    HL,0007
      **          0030'         CALL  $CHR
      **          0033'         CALL  $PV2D

0036 000F
      **          0036'         CALL  $END
                                error pointer, FOR-NEXT error FN

0041 000F

00002 FATAL ERROR(S)

13286 BYTES FREE

```

with additional machine code accessed by the linked program while it is running.

Compilation is best understood by following a program through the whole process. Programs are compiled in many ways, but the following procedure is used in almost all cases. (Other options, invaluable when needed, are rarely used.) First, write and debug a BASIC program (see listing 1). The program is then saved as an ASCII file, using the command:

SAVE "TEST1/BAS",A

(My most common error is forgetting to save it as an ASCII file; also, the BAS extension is needed for recognition by the compiler.) After returning to the DOS with CMD"S", the program is compiled by typing the command:

BASCOM TEST2,TEST3=TEST1

This will produce a listing file (called TEST3/LST) of the compiled code in assembly language (see listing 2) and a partially complete and relocatable machine-language program (called TEST2/REL) that must be linked to other machine code using L80. TEST1/BAS was the BASIC source program.

Error diagnosis is excellent—any errors in the BASIC source code will be listed to the screen and shown in the listing file (see listing 3). The command:

L80 TEST2,TEST4-N-E

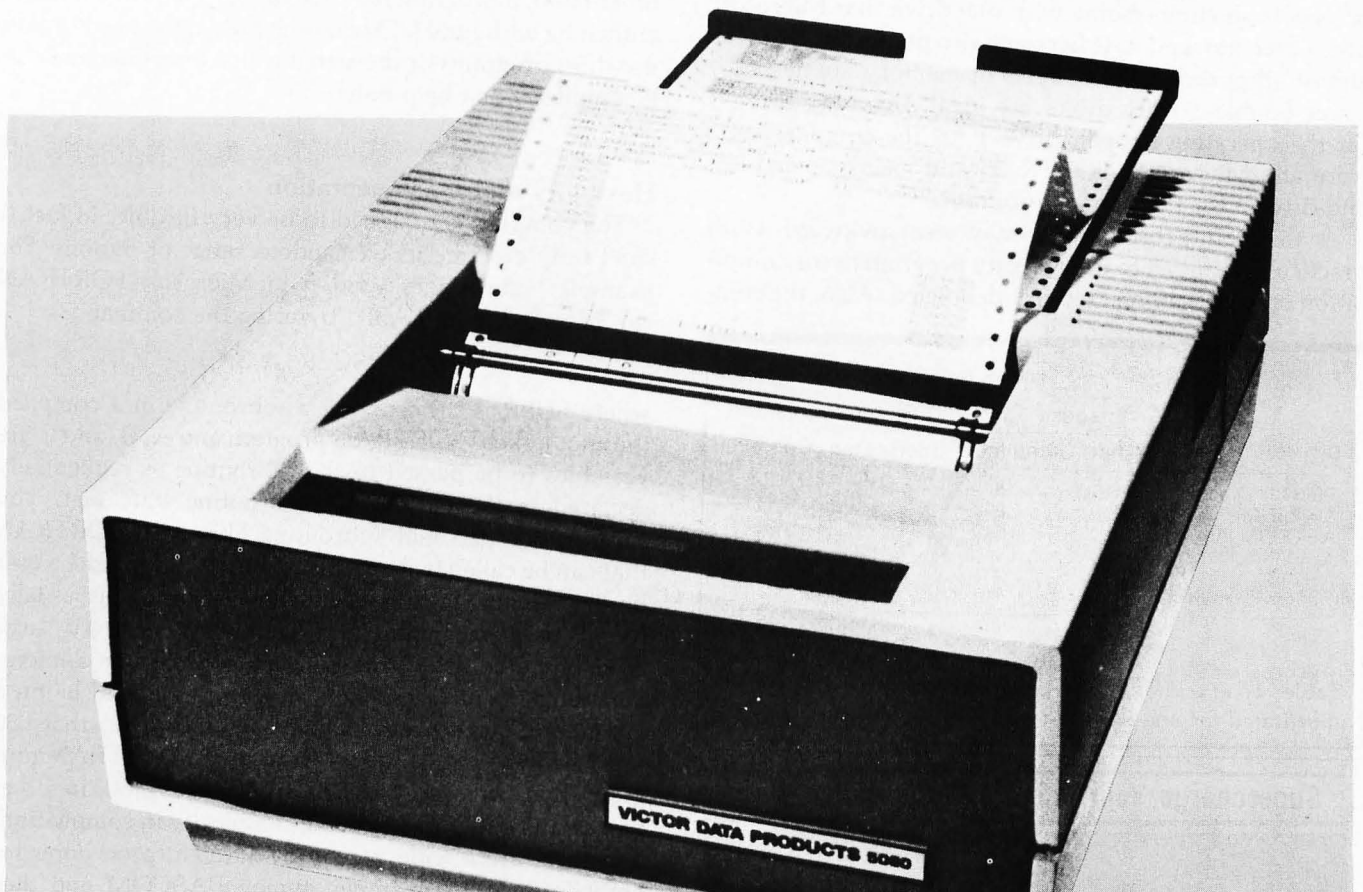
will link machine code from BASLIB/REL and produce the file TEST4/CHN (for chain) from TEST2/REL. The "-N" and "-E" are "switches" that in turn tell L80 to write the /CHN file to disk and exit to DOS. A variety of other switches are available for L80 and BASCOM. Again, errors will be listed to the screen. TEST4/CHN can then be run as a machine-language program with the command:

BRUN TEST4

Obviously BRUN/CMD must be available any time the program is run, but the other programs are unnecessary. Other names could have been used for any file, and disk drive numbers could have been specified. Usually, all of the names are the same (e.g., TEST/XXX). In that case, we create files called TEST/BAS, TEST/LST,



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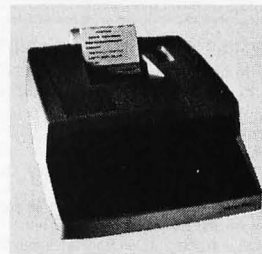
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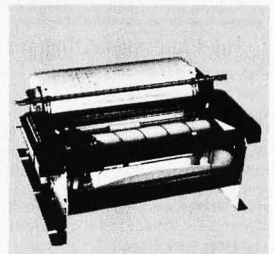
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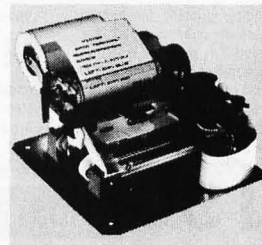
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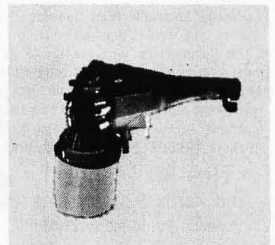
Model 5010



Model 80



Model 130



Model 129



TEST/REL, and TEST/CHN. If the compiled program runs correctly, the /LST and /REL files can be deleted.

Although the procedure I describe is used with three disk drives, the sequence is very similar using one or two drives, though disk swapping is necessary. Actually, the process is so cumbersome with one drive that Microsoft doesn't recommend it. (Microsoft also points out that, for almost all purposes, 48 K bytes of memory are needed.) Three double-density drives are ideal. I can use drive 0 for the operating system, drive 1 for the compiler software and Microsoft's FORTRAN and macro assembler, and drive 2 for the various programs.

At this point, the compiler may seem awkward. With practice, it's simple to use and any program needs compilation only once if interactively debugged. Also, the com-

pilation time is very short in relation to the run time if the program is to be run several times. There are some cases, however, when compilation is superfluous. For example, a program that spends most of its time with disk I/O (input/output) will gain little speed by compilation. On the other hand, a program that does a lot of iterative number crunching with little I/O will be greatly quickened. If you use short programs or those that wait a long time for I/O, a compiler won't help much.

### Flexibility and Documentation

The compiler is designed to be very flexible; in fact, I can't fully describe its tremendous range of options. For example, subroutines written in Microsoft FORTRAN can be called from BASIC by using the command:

CALL SUBR (A,B,C)

where SUBR is the name of a subroutine in a compiled (but not linked) FORTRAN program and A, B, and C are variables to be passed to the subroutine as sequentially declared in the FORTRAN subroutine statement. You can write a personal subroutine library in FORTRAN that can be called from BASIC. The ability to write a user library of language-independent subroutines is usually found only on mainframe computers or very large minicomputers. Working with the compiler on a microcomputer is much less awkward than it would be on a large computer system. This means, however, that L80 must have a provision for specifying a FORTRAN program that will be searched for subroutines. In other words, flexibility means some complexity in compilation, and there are a wide variety of different procedures for compilation. For example, typing BASCOM and then after a prompt:

TEST2,\*PR=TEST1

sends the listing to a line printer. Many other features are too complex and lengthy to be described here.

Unfortunately, this flexibility and complexity mean rather unclear documentation. Microsoft has tried to describe all of the options, special features, and peculiarities of the system before a user becomes acquainted with the rudiments. In some instances, the system's complexity seems to have confused even the writer of the manual.

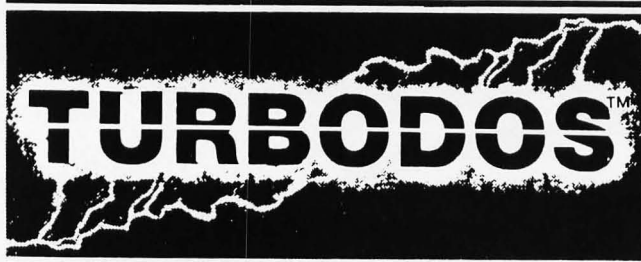
For example, in one section a COMMON statement is described in great detail, while another section tells us that it's not implemented. In another case, it gives an excellent table comparing Level II BASIC, disk BASIC, and "standard" Microsoft BASIC (BASIC-80) with compiled BASIC, but several statements and commands that are available in compiled BASIC (and BASIC-80) are omitted.

The manual is very complete and includes an introductory section (confusing); a technical section (also confusing) detailing the features of compiled BASIC; and the BASIC-80 manual that gives the syntax of statements not found in either Level II or TRS-80 disk BASIC, but with (distractingly) almost everything in the TRS-80 lan-

	TIMES (seconds)			
	Integer		Single Precision	
	Interpreted	Compiled	Interpreted	Compiled
PRINT(I)	45	18	55	39
A = PEEK(I)	39	2	44	14
A = LEFT\$("ABC",1)	37	6	38	9
A! = SIN(3.14159)	149	50	150	50
A = I + 2	40	2	44	8
FORJ = 1 TO 10: NEXT	169	4	188	8

Table 1: Execution speeds with the above statements substituted for line 30 in Listing 1.

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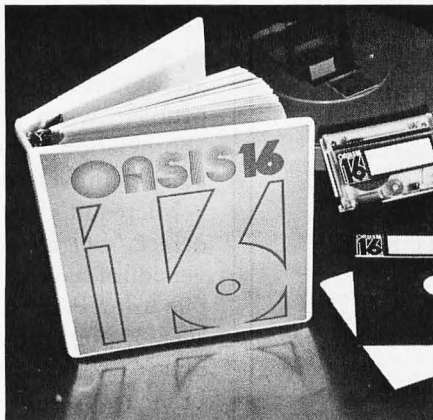
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guages described as well. I spent several days trying to decipher some simple features (like the CALL statement mentioned above), but everything I needed to know was eventually found within the several different sections. The software is easily used, but the simplicity is obscured by very confusing documentation. In fairness to Microsoft, I have seen much worse obfuscation in documentation from CDC, DEC, and IBM.

## Compatibility

The package is compatible with TRS-80 disk BASIC. Disk BASIC is more forgiving in some things, like FOR . . . NEXT loops, but if you use *legal* disk BASIC the compiler will recognize everything (except, of course, things like EDIT and CLOAD). CLEAR is not needed by the compiler, but if it's in the source program it will be ignored and a nonfatal error message will be given (which may be ignored). Also, there's no provision for data I/O with tapes. There are a few other minor differences, but

OPTION BASE	SWAP	WAIT
WHILE	WEND	WIDTH
FRE	HEX\$	OCT\$
INP(I)	INPUT\$	LPOS
POS	SPACE\$	SPC
CHAIN	%INCLUDE	

**Table 2:** Some statements, commands, etc., supported by Microsoft's compiled BASIC, but not by TRS-80 disk BASIC.

almost any program written in standard TRS-80 BASIC will compile successfully. The reverse, however, is not true. The compiler recognizes many statements and commands not used by TRS-80 BASIC.

## Speed

All compiled programs are much faster, but the compilation process itself takes some time. The trivial program in listing 1 took less than two minutes to compile and link. A game using 11K bytes took one minute and 46 seconds to compile and two minutes and 50 seconds to link without a listing file. With a BASIC listing file but no object code between the lines, compilation took two minutes and 11 seconds, and the listing file required about 14K bytes or 13 "grans." It was impossible to compile the program with object code; the listing file needed more than 100 grans of disk space. This is a problem with the compiler that's not mentioned in the documentation; object code listings may need more storage than is available on any blank disk. However, it's probably never necessary to get a complete listing file with object code. A "-N" switch after the BASCOM line will inhibit the object code.

Some differences in run times for various interpreted and compiled programs are given in table 1, which shows the execution times for statements placed in line 30 of listing 1. Speed increases vary from more than 40 times, with integer variables in simple functions, to less than three times faster using SIN, COS, and similar functions. Nevertheless, there's always a speed increase that varies depending on the program.

## Special Features

Compiled BASIC has many features unavailable in interpreted TRS-80 BASIC. In fact, they're not all listed in the documentation. Table 2 gives the additional statements and commands, although they are too numerous to fully describe. For example, SWAP( A,B ) exchanges the value assigned to the two variables, and transcendental functions will return double precision. Perhaps the most important are WHILE and WEND statements; they allow writing structured program code. Variables may be of any length; that is, the compiler will consider J, JOS, and JOSEPH to be different variables. This may pose a problem when compiling a program that uses variable abbreviations; the compiler may recognize more variables than were originally intended.

Microsoft's original BASIC compiler had many defects, but all of the problems seem cured in this new version. I have some BASIC programs that will not compile using BASCOM, but that's always because standard TRS-80 conventions were not used. For example, Radio Shack's backgammon game will not compile because it branches to subroutines from within a loop; that is disallowed but forgiven by interpreted BASIC. Also, some things may be mistaken for bugs. For example, I thought there were problems with linking because L80 is different for Microsoft FORTRAN and BASIC. But the two act the same if a "-R" switch is used with the BASIC version.

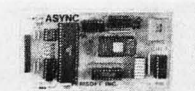
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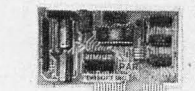
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I've yet to find any "real" bugs—only things that I either misinterpreted or didn't understand.

If you have code that you want to run faster, or if you need any of the features like a FORTRAN library, this is definitely a worthwhile product. If you're not accustomed to a compiler, compilation may be annoying. But this is a professional package, just as flexible and much easier to use than some compilers on mainframe computers.

## Conclusions

Microsoft's BASIC compiler allows compilation of any BASIC program written for a disk-based TRS-80. This results in a three to 30 times increase in execution speed. The system includes a compiler (BASCOM), linker (L80), routine library (BASLIB), and run-time package (BRUN). For most purposes, 48 K bytes of memory and two disk drives are needed. The package is nearly identical to the interpreter that Microsoft designed for the TRS-80.

The software is readily used by those familiar with a compiler and compilation is quick. The documentation is confusing but complete, and a novice should be operating the system within an hour. Full use of its very flexible and extensive special features will require several days' study, which would be reduced with better documentation.

There are more than 20 features in the package that are not available in disk BASIC, including structured loops

and calls to FORTRAN subroutines. Because of ambiguities in documentation, full use of the features requires long study and experimentation.

This is a very professional software package that gives the TRS-80 features found only on much larger systems. Except for the documentation, the package is superlative in all respects. ■

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## LDOS—Disk Operating System for the TRS-80

Tim Daneliuk  
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The TRS-80 microcomputer has evolved from a rather simple, cassette-based experimenter's delight to a complex and powerful disk-centered system. With disks came the necessity of a DOS (disk operating system) for control and communication with the computer. The first DOS came from Radio Shack, but independent vendors have since released others. The latest of these is LDOS from Logical Systems Inc.

LDOS was created out of need. Lobo Drives International wanted to market a new disk interface for the TRS-80 Model I that supported not

only 5¼-inch floppy disks, but 8-inch and hard disks as well. Additionally, the floppy-disk interface supported both single- and double-density operation. At the time of the hardware design, no existing DOS could support this diversity of hardware. Therefore, LDOS was created. Originally, it started as a debugged and enhanced version of VTOS 4.0. However, the present version is essentially all new code. VTOS users will be quite comfortable with LDOS because the command structure and syntax of VTOS have been largely maintained. The present version of LDOS supports both the Radio Shack expansion interface and the Lobo LX-80 interface. It is compatible with TRSDOS 2.3. Also, it supports both the Percom Doubler and double-sided operation. A version of LDOS is also available for the TRS-80 Model III.

It is always difficult to review a software product of this magnitude. I hope I have successfully avoided the tendency to get lost in infinite detail. I will stress the highlights of the system based on extensive use of LDOS 5.0.2 on a Model I and limited use of LDOS 5.1 on a Model III. The features discussed reflect primarily LDOS 5.1. As this is being written, this latest version, called 5.1.1 for the Model I, has just been released. Therefore, the operating features of both Model I and Model III LDOS are identical.

### The LDOS Command Library

TRSDOS 2.3 could be viewed as a subset of LDOS. Every TRSDOS command has been implemented, and

most have been significantly enhanced. LDOS also provides many new commands never previously available on any one TRS-80 DOS. Table 1 contains a brief listing and descriptions of the major enhancements and extensions found in LDOS. The major features are described below.

If you do any assembly-language programming, you will find the LDOS extended DEBUG a tremendous tool. All of the old commands are included, but many new ones have been added, too. Some of the extensions are:

- enter data directly into entire sections of memory
- fill a block of memory with a specific byte
- jump over a byte in program execution
- locate first occurrence of a specific byte or word in memory
- print a block of memory
- send or display a byte to or from any I/O (input/output) port
- type ASCII (American Standard Code for Information Interchange) characters directly into memory
- compare two blocks of memory

There is also a disk read/write utility that allows reading or writing to any sector of any disk, even the directory sectors!

The fact that LDOS supports hard disks and 8-inch floppy disks is evident in the changes to the DIR (directory) command. An unconditional call for a disk directory on a 10-mega-byte hard disk would be a messy proposition. LDOS allows directories

### At a Glance

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**Type**

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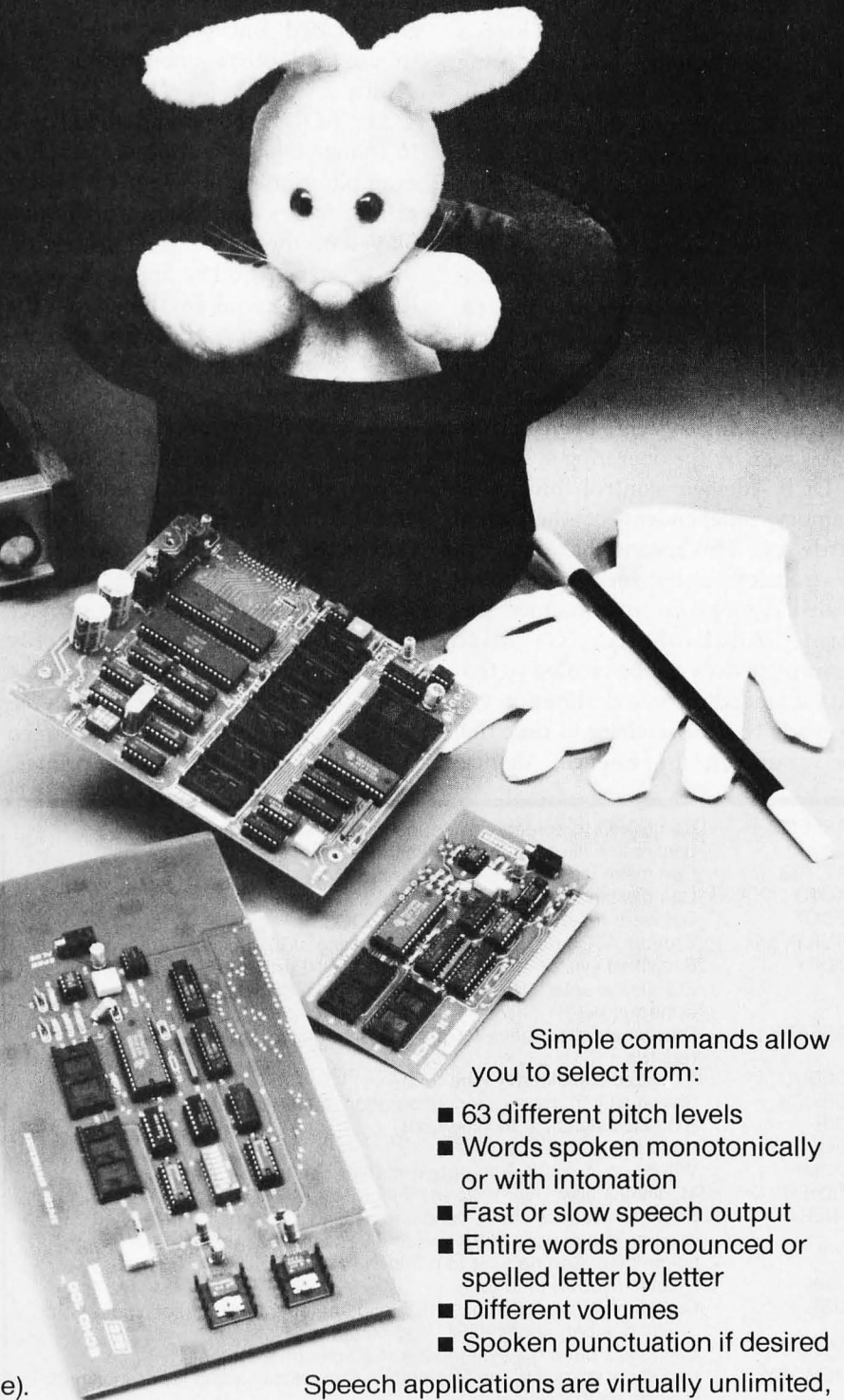
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by class and date. For example, a directory of only files with the extension "/TXT" could be shown. Or all files created on, before, or after a specific date could be shown. This is a real time-saver when you are trying to find a specific file in a full disk. Any DIR command also shows the amount of free space in kilobytes on a specific disk, as well as the usual disk name, creation date, and drive number.

The LINK and ROUTE commands are very sophisticated and offer features normally found only on mini-computer and mainframe operating systems. LDOS is a device-independent operating system. Each peripheral is seen by the operating system as a DCB (device control block) in memory independent of the actual hardware. This means that data can be transferred between peripherals (called devices) in any manner you want. Additionally, so-called dummy-devices can be created so that data intended for one destination can be made to go elsewhere (a disk file, for example). In essence, device-

independence allows you to redirect I/O any way you like without having to rewrite the machine-language I/O drivers. This may sound terribly complicated, but it is extremely easy to use and offers unbelievable versatility.

The ROUTE command allows you to change the destination of data. For example, routing the video to the line printer forces anything normally displayed on the screen to be printed on the printer. Another application for ROUTE is to send anything from the RS-232 serial port to a disk file, instead of the screen, when the computer is unattended. LINK is similar to ROUTE in function. However, instead of redirecting data to another device, it simultaneously adds a second (or third, or fourth . . .) destination device. This would allow you to send anything appearing on the screen to the printer, too, or vice versa. I have a disassembler that only goes to the screen. By linking the video display to the printer, the disassembled code appearing on the screen is simultaneously sent to the printer,

thus providing hard copy. The LINK command takes 10 seconds to type in; writing a new I/O driver could have taken days.

The SPOOL command has many uses, but its greatest application is when long printouts are required. Rather than tying up the computer completely while printing, SPOOL sends the data to be printed to a buffer located in memory or on a disk. Then, as the computer has time (in between keystrokes, for example), the data are sent to the printer. You can choose the size of the buffer, as well as whether to spool to memory or the disk. When using SPOOL, it seems that the TRS-80 is doing two things at once. However, it's just using time much more efficiently! Small-business users will love this feature because you can print a long report or a general ledger and use the computer for other things at the same time.

A final highlight of the LDOS library is the SYSTEM command. This allows you to customize LDOS for a particular installation. The disk-drive stepping rate, blinking cursor, keyboard type-ahead, and break key disable are but a few of the many features that can be configured. The final configuration can then be saved. Each time that LDOS system disk is booted, the configuration is also loaded. SYSTEM will be a real favorite with a single-drive user because it allows you to load many of the "/SYS" files into memory. This in turn frees a great deal of disk space for data. It also has the effect of speeding up disk I/O since overlays are not being called from the disk. Potentially, you could have the full operating system at your disposal, and about 60K bytes of disk space in a single-drive, single-density, 35-track system. Finally, SYSTEM allows you to reassign which physical drive is logical drive 0. You must load LDOS the usual way, but after that anything goes. This will find application among Model III users who have a 35-track drive left from their Model I. By making this external drive the system drive, the two higher-capacity 40- or 80-track drives in the Model III

APPEND	Can ECHO to screen while appending, and can back up 1 byte in destination file to merge Scripsit files.
ATTRIB	Can make files VISIBLE and INVISIBLE.
AUTO	Can disable BREAK key.
BOOT	Software reset "button." Reloads LDOS.
BUILD	Creates ASCII or HEX files for PATCHing, JCL, etc.
COPY	Simplified syntax. Can specify LRL. CLONE attributes of source file. ECHO characters to screen while copying. Single-drive copy from non-system disk.
CREATE	Preallocate disk space for a file in either kilobytes or number of records.
DEBUG	Extended significantly (see text).
DEVICE	Shows all important disk-configuration data.
DIR	Extended significantly (see text).
DO	Used to execute JCL file.
DUMP	Will dump in ASCII. End of text marker can be specified.
FILTER	Modify I/O flow.
FREE	Shows amount of space used and available, creation date, disk name, number of directory entries used and available, free space in K, and space map. Can be sent to printer.
LINK	Change I/O flow (see text).
LIST	Can number lines, dump in HEX, expand tabs, begin at specific record or line number, specify LRL, and output to printer.
LOAD	Can load from a nonsystem disk in single-drive systems.
MEMORY	Can show or modify top of memory. Can display, jump to, or modify specific memory locations.
PURGE	Multiple kill of files.
RESET	Reconnect peripherals to standard I/O drivers.
ROUTE	Modify I/O flow (see text).
RUN	Execute file from nonsystem disk on a single-drive system.
SET	Connect device to new I/O driver routine.
SPOOL	Data spooler (see text).
SYSTEM	Configure system parameters (see text).

**Table 1:** The major enhancements of LDOS as compared to TRSDOS 2.3. Not all library features are listed here.



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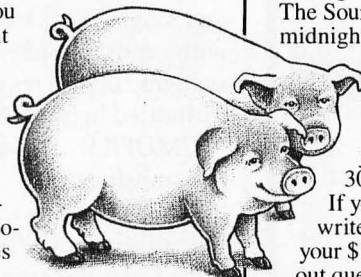
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### LDOS Utilities

LDOS includes the familiar BACKUP and FORMAT utilities, which have been greatly enhanced, plus several new utilities. As with the command functions, BACKUP and FORMAT provide support for larger disk drives. BACKUP by class can be invoked, for example, to back up only nonsystem files. FORMAT provides the necessary functions to format disks of various sizes, densities, and single- or double-sided usage. As with most sophisticated operating systems, LDOS requires that a disk be formatted before a backup is allowed.

CMDFILE is a utility that allows the transfer of files stored on tape to disk, or vice versa. Where necessary, the utility will offset program locations from the tape version to insure that no conflict with the operating system is encountered. Disk-to-disk transfers are also supported. The PATCH utility allows modification of disk files to make minor changes or repairs without having to rewrite the entire file. Model III LDOS comes with a CONV utility to convert Model III TRSDOS disks to LDOS.

A final utility of interest is LCOMM. It provides communications software compatible with both the Radio Shack and the Lobo LX-80 serial ports. This is *not* a "dumb-terminal" program, but a full-blown communications package with features like file transfers and downloading.

### LDOS Filters and Drivers

One of the unique features of LDOS is its ability to "filter" data. By loading an appropriate program, it is possible to modify data before they are sent to a particular device. Three such filters are provided with LDOS, but documentation is provided to help the assembly-language programmer write others. The KEYSTROKE MULTIPLY filter allows you to program any key to generate a phrase when pressed. I programmed some commonly used BASIC phrases into my keyboard. By pressing CLEAR and G together, the phrase GOTO is

generated. Another possible application for this filter would be to reduce complicated DOS commands to a single keystroke. LDOS does provide abbreviation for certain commonly used library commands such as FREE and DIR by means of the MINIDOS filter. The third filter is the PRINTER filter. Its features include adding a linefeed after a carriage return, specifying the number of characters to be printed on a line, and setting the left margin of the printed page.

Logical Systems is also releasing an entire disk of filter routines to be used with LDOS. This disk will sell for \$60. It has many extended features, such as redefining every ASCII character. This would allow, for example, translation from ASCII to another data code such as EBCDIC. Another filter on this disk allows decimal and hexadecimal arithmetic while in another program (EDTASM, for example).

LDOS has a provision for loading custom I/O drivers as well. With one command, it is possible to change peripheral control from the LDOS drivers to one you have written. An RS-232 driver is provided for applications involving the serial port.

### Job Control Language

It is impossible to do justice to the Job Control Language (JCL) feature short of writing a separate review of it. This is essentially a way of writing programs using LDOS library commands. Let's say you want to load a disk, and from then on have hands-off operation while the computer updates your mailing list, realphabizes it, and prints labels. Normally, you would have to type in four separate DOS and BASIC commands:

```
BASIC
RUN "NEWDATA"
RUN "ALPHABET"
RUN "LABELS"
```

In LDOS, you simply create a file with these commands in it (using the LDOS BUILD command or a text editor such as Scripsit). Then tell LDOS to DO this file and sit back! Program execution is automatic. JCL



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also has the capability of prompting the user for input from the keyboard, to make decisions, to wait for a specific time on the clock before executing, and many other features. One application could be running long business programs unattended at night. This feature alone is worth the entire package price.

## LBASIC

As with Disk BASIC 2.2, LBASIC is an adjunct to the BASIC interpreter in the TRS-80. It is compatible with programs written in Radio Shack BASIC, but has extended features that significantly enhance the language.

LBASIC adds many new random and sequential file controls. One of the best is the implementation of the Blocked File mode. In this mode of operation, an LRL (logical record length) between 1 and 256 bytes per record may be selected. This means that although the physical record size is still 256 bytes per record, you can deal with logical records that are less

than this. Let's say you wanted to write a random-access file that contained nothing but names up to 32 characters long. Rather than FIELDing the buffer for eight separate data fields and writing 256-byte records, LBASIC allows you to have records that are exactly 32 bytes long as far as *you* are concerned, while maintaining actual physical records that are 256 bytes. Another random-access file control, OPEN, has been modified to allow the opening of a file only if it already exists or, conversely, only if it does *not* already exist.

The sequential file controls have been enhanced as well. It is now possible to write to the end of (append) a sequential file directly without having to first load the file into memory, modify it, and write it back to disk. As with the random files, OPEN can be made dependent upon whether the file does or does not already exist.

LBASIC implements some features that greatly enhance writing and debugging programs. The more com-

monly used BASIC commands such as AUTO, EDIT, and LIST have been reduced to a single-letter command, and it is possible to single-step through a BASIC program. To facilitate program documentation and debugging, LBASIC includes a powerful line-renumber command and a cross-reference generator.

Several totally new BASIC commands have been added. RESTORE lets you go to a specific line of a program rather than always to the first DATA statement. When chaining programs, it is possible to specify at what line of the next program execution is to begin. Variables can also be passed from program to program while chaining. Thus, it is no longer necessary to save the variables in a file and read them back in when the next program has been loaded. A final addition is the ability to reset the EOF (end-of-file) marker in a random file, effectively allowing you to make random files smaller at will.

A final enhancement in LBASIC is the extended use of the CMD com-

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mand. Any legal LDOS command that does not affect protected memory can be executed from within LBASIC. To do a directory, for example, simply type in CMD "DIR". You can also load "/CMD" files from LBASIC by typing in CMD "filespec".

## Documentation

It is claimed that of the approximately \$100,000 spent on the LDOS project, the manual alone cost more

than \$25,000 to develop. This is not difficult to believe because LDOS has the best, most comprehensive documentation and manufacturer support I've ever seen for a microcomputer. In excess of 250 pages, the LDOS manual is plainly the work of professionals. It will bring particular joy to assembly-language programmers because all major system entry vectors are thoroughly documented and all old *documented* TRSDOS vectors

have been maintained. (I gained a great deal of insight into TRSDOS by reading the LDOS technical section.) The nontechnical user is by no means left out though. The manual is extremely readable and full of good examples.

The documentation is further supported by a toll-free telephone number, an excellent update policy, a Micronet bulletin board, and a quarterly news magazine. The phone-in customer service is available for four hours daily. The magazine is free for the first year. New releases of LDOS can be obtained by sending \$5 and the original master disk to the manufacturer. If you prefer, you can update LDOS by logging in to Micronet and copying the updated version at no charge. As newer versions of LDOS become available, existing owners will be able to upgrade to the new version for a nominal fee (depending on the nature of the new revision). In short, the LDOS documentation and support system have no peers. They can be expected to become the standard by which all others are measured.

## Benchmarks

LDOS boots quickly and seems to operate quite efficiently. One of its nicer features is the fact that the real-time clock is kept on during disk I/O operation. While this keeps the clock much more accurate than other systems, it can lead to a rather mysterious problem. If the disk drive is turning at exactly 300 rpm (revolutions per minute), the interrupt for the clock can occur at the same time the directory track becomes available to be read. This can result in long waits during disk I/O. The problem is remedied by reducing disk-drive speed by several rpm. The first quarterly magazine includes a BASIC program that indicates drive speed allowing you to see if your drives need a slight readjustment. The 15 minutes it takes to do this minor correction is a small price to pay for the added clock accuracy, though, and the problem is intermittent and minor at most.

Listing 1 is the Benchmark program used to compare the speeds of LDOS

Listing 1: The Benchmark program used to compare the speed of TRSDOS and LDOS.

```
100 CLEAR 1000
110 CLS
120 DEFINT A-Z
130 ' ** Program to test speed of system **
139 ' Set display delay
140 DODELAY=2000
200 PRINT@256,"Do You wish to make a <R>ead or <W>rite test
??"::INPUT MODE$
210 ' Set Read or Write mode
220 IF MODE$="R" OR MODE$="r" THEN MODE=0:GOTO 300
230 IF MODE$="W" OR MODE$="w" THEN MODE=1:GOTO 300
240 GOSUB 9999:GOTO 200
300 CLS
310 PRINT@256,"What is the name of the file to use ??"::INPUT
FILE$
320 IF LEFT$(FILE$,1)<"A" OR LEN(FILE$)>12 THEN GOSUB 9999:GOTO
300
340 CLS
350 PRINT@256,"Which drive shall be used (0 to 7) ??"::INPUT
DRIVE$
360 IF LEN(DRIVE$)>1 OR VAL(DRIVE$)>7 THEN GOSUB 9999:GOTO 340
370 CLS
380 PRINT@256,"What Logical record length (1 to 256)??":INPUT
LRL$
390 IF VAL(LRL$)<1 OR VAL(LRL$)>256 THEN GOSUB 9999:GOTO 370
400 CLS
410 PRINT@256,"How many records shall be Processed ??"::INPUT
REC
420 IF MODE THEN CLS:PRINT@256,"If the file exists do You want
it KILLED (Y/N) ??"::INPUT KI$: ELSE GOTO 500
430 IF KI$="Y" OR KI$="y" THEN KI=1
500 CLS
510 FILE$=FILE$+" "+DRIVE$:PRINT@256,"Filename      : ";FILE$
520 PRINT@384,"      Record size : ";LRL$
530 PRINT@512,"      # of Records : ";REC
540 PRINT@640,"      File MODE   : ";IF MODE
THEN PRINT"WRITE" ELSE PRINT"READ"
550 PRINT:PRINT"IS THIS CORRECT (Y/N) ??"::INPUT GO$
560 IF GO$="n" OR GO$="N" THEN RUN
600 IF KI THEN ON ERROR GOTO 15000:IF MODE THEN KILL FILE$
601 ON ERROR GOTO 0
602 Q$="HELLO"+"GOODBYE"
605 SIZE=VAL(LRL$):IF LRL$="256" THEN LRL$=""
610 OPEN"r",1,FILE$,VAL(LRL$):FIELD #1, SIZE-1 AS REC$
620 PRINT@288,"START   :";TIME$
630 PRINT@416,"FINISH  :";
640 PRINT@544,"RECORD  :";
690 IF MODE THEN 800
700 FOR L=1 TO REC:PRINT@552,L:GET 1,L:IF REC$=Q$ THEN 1000
ELSE NEXT:CLOSE:GOTO 900
800 FOR L=1 TO REC:PRINT@ 552,L:LSET REC$=STR$(L)+"This is a
test of file handling in Basic":PUT 1,L:NEXT:CLOSE:GOTO 900
900 PRINT@424,TIME$:PRINT@900,,:END
1000 PRINT" E R R O R ":GOTO 900
9999 CLS:PRINT@400," I N V A L I D   R E S P O N S E ";
10000 FOR TIMER= 1 TO DODELAY:NEXT ' ** PAUSE LOOP
10001 CLS:RETURN
15000 RESUME NEXT
```



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and TRSDOS. Table 2 is a summary of the results of that benchmark. For the Model III, TRSDOS 1.3 was used. The Model I benchmark presented a problem since TRSDOS 2.3 does not officially support variable LRLs (i.e., logical record lengths less than 256 bytes). The latest version, TRSDOS 2.3B, does support variable LRLs on the Radio Shack Compiler BASIC package, but not with the interpreter. Variable LRLs are partially implemented in TRSDOS 2.3 and 2.3B, but they cause errors to occur. In investigating this, I discovered that it was possible to write records in this file mode, but not to read them. Furthermore, the write procedure appeared to work fine, except that when the file was to be CLOSED an error message appeared. Consequently, the timings given for TRSDOS on the Model I should not be treated as true benchmarks. They are included here only as a point of interest. It is interesting to note that, even with the errors being generated, the figures for the Model I and Model III are remarkably similar. This seems to indicate that, if Radio Shack ever implemented variable LRLs on the Model I, no significant improvement in efficiency could be expected unless the entire procedure was rewritten.

### Summary and Conclusions

It is probably apparent that I really like LDOS. It is by far the most sophisticated piece of systems software available for the TRS-80 (and probably for any computer priced under \$5000). It offers unprecedented features, giving the TRS-80 new applications previously impossible without a massive programming effort. I had been considering selling my Model I and upgrading. After using LDOS, it became apparent that, while I might improve the hardware, I would be hard-pressed to come up with a more usable and better supported system in an affordable price range.

Specifically, LDOS offers these unique features:

- A user-oriented DOS that doesn't require in-depth technical knowledge to use well.

- A level of documentation and technical support almost unheard of in anything but minicomputers and mainframes.

- Virtually problem-free operation. In the months I have used LDOS, the only problem encountered was the disk-speed problem mentioned earlier.

- The possibility of true portability between members of the TRS-80 family, as well as some S-100 computers. Versions of LDOS for the Model II and certain S-100 computers are planned. These will probably be CP/M-compatible to some extent and will allow transporting data disks between any machines running under LDOS (provided the media are compatible).

- An exceptional bargain! If the in-

dividual features of LDOS were bought separately, the price would be near \$1000. The SPOOL feature alone would cost almost as much as the complete LDOS package.

It is difficult to conceive of a TRS-80 user who would not benefit from LDOS. In fact, the overall programming efficiency should at least double. Even if you are using another advanced DOS, it would be worthwhile to look into LDOS because its advanced features are yet to be rivaled in any one competitive operating system. If you are about to purchase a disk system or a new DOS, you'll find LDOS to be a professional, debugged, and efficient tool that will free your time and talents to write better applications software. ■

Function	Model III				Model I			
	TRSDOS 1.3		LDOS 5.1		TRSDOS 2.3B		LDOS 5.0.2	
	Real Time	Clock Time	Real Time	Clock Time	Real Time	Clock Time	Real Time	Clock Time
Write New File LRL = 2 2000 Records	13:23	2:09	1:28	1:28	13:36	-----	1:37	1:38
Write To Existing File LRL = 2 200 Records	1:21	0:13	0:09	0:09	1:23	-----	0:11	0:11
Read Existing File LRL = 2 2000 Records	6:37	1:54	0:49	0:49	-----	-----	1:05	1:06
Write New File LRL = 128 200 Records	1:52	0:26	1:05	1:05	1:42	-----	1:28	1:30
Write New File LRL = 256 100 Records	-----	-----	-----	-----	0:45	0:20	0:55	0:55
Read Existing File LRL = 256 50 Records	-----	-----	-----	-----	-----	-----	0:10	0:11

**Table 2:** The results from the Benchmark program. Times given are in minutes and seconds. Blank spaces indicate tests not run on the Model III, or not possible with the Model I.



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## COBOL for the TRS-80 Models I and III

Rowland Archer Jr.  
Flint Ridge Apartment 59  
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COBOL on a TRS-80 Model I? Yes, I was skeptical myself. Visions of COBOL's notoriously verbose source code rapidly filling memory and floppy disks led me to believe that Radio Shack had probably exceeded the limitations of the TRS-80 this time. I have been surprised in the past by some things people have converted from mainframes and minicomputers to microcomputers, but COBOL seemed like too much. Now, after substantial use of the system, I can happily report that Radio Shack's COBOL package is professionally done and well suited to the TRS-80.

COBOL is the most widely used programming language in the world. Over the years, the American National Standards Institute (ANSI) CODASYL committee has overseen the evolution of COBOL into a powerful language highly suited for business applications. It is particularly strong in its file-handling capabilities. Also, Radio Shack has announced that all the business-application software it develops in the future for the TRS-80 Model II will be done in COBOL.

Radio Shack COBOL (RSCOBOL) is a complete COBOL program development system. It implements a substantial portion of the ANSI X3.23-1974 COBOL Standard (the most recently approved standard). The package contains two 5¼-inch

floppy disks for the TRS-80 Model I and one for the Model III. My report is based on the use of the Model I system. The Model III version is supposed to be functionally identical.

The disks contain:

1. CEDIT, a line-oriented text editor for preparing COBOL source programs. This editor is similar to the one provided with the Model I EDTSAM (Editor-Assembler) package, with tab settings for COBOL and several additional commands.

2. The RSCOBOL compiler supplied in Z80 machine-language format. It produces an object file, listing file, and cross-reference list in a single pass over the source code.
3. The RUNCOBOL run-time package, including an interactive COBOL debugger. The output of the RSCOBOL compiler can be run immediately with no need to go through a linking/loading phase, such as the one required by Radio Shack's FORTRAN package.

### At a Glance

**Name**

RSCOBOL

**Type**

TRS-80 COBOL development system

**Author**

Ryan-McFarland Corporation  
Software Products Group  
Aptos, CA 95003

**Distributor**

Tandy Corporation  
One Tandy Center  
Fort Worth, TX 76102  
(817) 390-3583

**Price**

\$199

**Software**

All software needed to run COBOL on both Model I and Model III TRS-80s, provided on three 5¼-inch floppy disks. This includes a line-oriented text editor,

overlayed COBOL compiler, interactive COBOL debugger, and run-time package.

**Software Format**

Model I version requires TRSDOS 2.3B, which is provided with the package; Model III version requires TRSDOS 1.1, which is also provided.

**Computer**

TRS-80 Model I or III with 48K bytes of RAM and at least two disk drives

**Documentation**

Concise but complete explanation of system operation; lengthy and thorough description of language; written in the style of a reference manual, not a tutorial; 368 pages.

**Audience**

Programmers in need of a COBOL development system for the TRS-80 Model I or III



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## A New TRSDOS?

TRSDOS 2.3B is being provided with RSCOBOL, the new RSBASIC Model I BASIC Compiler, and the Series 1 Editor/Assembler. Each of these packages requires TRSDOS 2.3B and will not run under older versions of TRSDOS or other disk operating systems from alternate vendors (at least not at the time of this writing; the alternate DOS vendors will probably do something to remedy this situation).

Because of its dependence on certain features of TRSDOS 2.3B, the RSCOBOL package cannot be used without modification on systems that support double-density disk storage on the Model I, such as LDOS and NEWDOS/80, although the extra disk storage would certainly be useful for this package.

A utility, UPGRADE, is provided to convert a disk made with older versions of TRSDOS to run under 2.3B. However, once the disk is upgraded it can no longer be used with an older TRSDOS. UPGRADE also deletes any system (TRSDOS) files that happen to be on the disk being upgraded. Therefore, make sure you really want this to happen before you run the program!

The major change to TRSDOS is in the way it maintains the end-of-file (EOF) information in a disk's directory. The old systems maintained a 2-byte count of sectors in use by the file, plus a 1-byte offset of the last byte in use in the last sector. The new system maintains these 3 bytes differently. Together, the 3 bytes comprise a true total byte length of the file; if the EOF offset byte is not zero, the sector-count byte is one less than it was under the old system.

Ironically, this is the way Apparat's NEWDOS systems have always maintained the EOF internally. It was a "correction" to TRSDOS 2.1 noted in the documentation for NEWDOS 2.1, released more than two years ago. NEWDOS systems, however, convert the EOF data to be compatible with TRSDOS 2.3's "incorrect" method when they write the EOF to the disk directory. This makes NEWDOS-created disk files compatible with TRSDOS 2.3 and earlier systems, but incompatible with TRSDOS 2.3B—which uses the NEWDOS EOF method not only internally, but also in the disk directory. If you are confused, imagine the fun this creates when you have disks generated by both systems in your library!

In practice, this means that any machine-language program that does physical record disk I/O and maintains the EOF pointer itself will not function properly under TRSDOS 2.3B. For example, you cannot use Radio Shack's Scripsit to edit RSCOBOL source files without using a utility to move the files back and forth between TRSDOS 2.3 and 2.3B disks. However, Radio Shack provides only a utility for converting all the files on a 2.3 disk to 2.3B format. It is unfortunate that Radio Shack had to make these changes to TRSDOS, as they will certainly cause lots of confusion for thousands of TRS-80 users. [Editor's Note: TRSDOS 2.3B is not a replacement for TRSDOS 2.3. Radio Shack says it is only required for use with the RSCOBOL, Series 1 Editor/Assembler, and RSBASIC Compiler packages. ... SJW]

## New TRSDOS

One of the biggest surprises of this package was the introduction of a new version of DOS (disk operating system) for the Model I, TRSDOS 2.3B. I had seen no mention of this upgrade when I purchased RSCOBOL. Although this new release is only slightly different from TRSDOS 2.3, one of its changes is significant enough to make 2.3B disks

incompatible with any other TRS-80 disk operating system, including NEWDOS, LDOS, TRSDOS 2.3, and its predecessors. This raises many "interesting" (read "painful") problems with file sharing between the various systems.

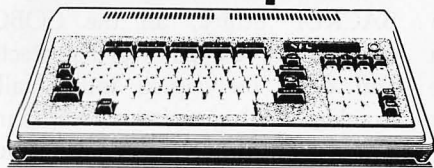
## System Overview

The RSCOBOL system is heavily disk oriented. It requires two disk



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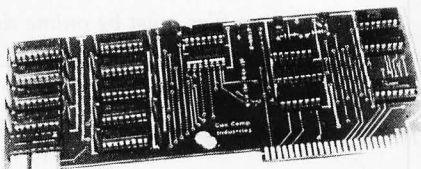
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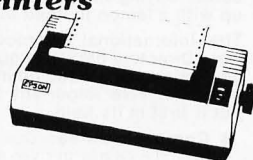


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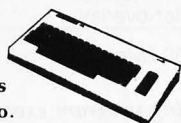
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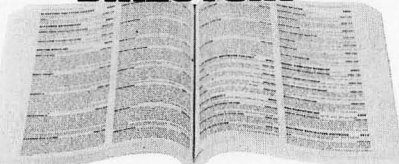
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drives. Since the compiler and the run-time module both use overlays, these disks must always be online during compilation and execution.

During compilation, the files in table 1 must be online. During execution of COBOL programs, the files in table 2 must be online. The best way to set up the disks in a two-drive system has the disk in drive 0 containing TRSDOS and either all the files needed to compile a program or all the files needed to run one. This allows the disk in drive 1 to be formatted as a "data disk," with all its space available for COBOL source code, object code, and/or the files used by applications programs. In fact, the disk containing both TRSDOS and the run-time system has enough space for a sizable COBOL object program, allowing drive 1 to be used entirely for data.

Unfortunately, Radio Shack didn't see it this way and its disks are set up differently. Only the run-time disk contains the TRSDOS system files. This disk does *not* contain the run-time debugger overlay, RSCBLD13/OBJ. That file is on the disk that must go in drive 1. The second disk con-

tains the COBOL compiler, all overlays, and the COBOL editor. Even since this disk does not contain TRSDOS, you must have a disk containing TRSDOS in drive 0 while you are compiling. Where should you put your COBOL source code and object code? Take your pick, but you must share space on the same disk with either TRSDOS or the compiler and its overlays.

Why the fuss about file placement? After all, can't you just use COPY to move the files around to achieve more logical placement? Due to an inexplicable move on Radio Shack's part, you can't. Although the disks as a whole can be copied using BACKUP utility, all the COBOL system files are password protected and can't be copied individually. Frankly, the logic of this escapes me. There is no protection against piracy as both disks may be copied freely with no restrictions. But the license owner of the system is prevented from moving individual files around to increase the usefulness of the system. Does anyone in Fort Worth care to explain this policy? It is either a slip-up or Radio Shack is trying

File	Function	Size, GRANS
RUNCOBOL/CMD	COBOL Run-time	25
RSCBLD13/OBJ	Debugger overlay (Only needed if debugger is used)	2

\*One GRAN = five 256-byte sectors, or 1280 bytes.

Table 1: These files must be online during program compilation.

File	Function	Size, GRANS
RSCOBOL/CMD	COBOL Compiler	23
RSCBL213/OBJ	Compiler overlay	6
RSCBL313/OBJ	Compiler overlay	6
RSCBL413/OBJ	Compiler overlay	5

\*One GRAN = five 256-byte sectors, or 1280 bytes.

Table 2: These files must be online during program execution.



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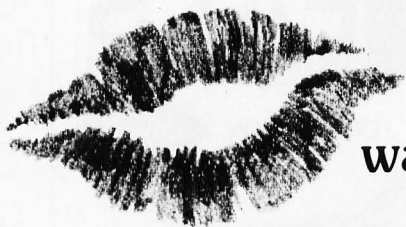


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**Listing 1:** A sample program created using the COBOL development system. The program searches sequential disk files for records that match the key entered by the user. For a further explanation of how this COBOL program operates, see the text box on page 392.

TRS-80 Model I/III COBOL (RM/COBOL 1.3B) 08/17/81 08:30:52 PAGE 1  
SOURCE FILE: SAMPLE OPTION LIST: (T X L=1 O=1

```

LINE  DEBUG PG/LN  A...B.....
1      000100 IDENTIFICATION DIVISION.
2      000110 PROGRAM-ID.
3      000120 SAMPLE.
4      000130 AUTHOR.
5      000140 ROWLAND ARCHER.
6      000150 DATE-WRITTEN.
7      000160 29 JULY 1981.
8      000170
9      000180 ENVIRONMENT DIVISION.
10     000190
11     000200 CONFIGURATION SECTION.
12     000210 SOURCE-COMPUTER.      RMC.
13     000220 OBJECT-COMPUTER.      RMC.
14     000230
15     000240 INPUT-OUTPUT SECTION.
16     000250 FILE-CONTROL.
17     000260 SELECT INFILE ASSIGN TO INPUT, "INFILE/DAT:1".
18     000270
19     000280 DATA DIVISION.
20     000290
21     000300 FILE SECTION.
22     000310 FD INFILE
23     000320 LABEL RECORDS ARE OMITTED.
24     000330 01 INFILE-RECORD      PIC X(80).
25     000340
26     000350 WORKING-STORAGE SECTION.
27     000360
28     000370 01 IN-RECORD.
29     000380 05 RECORD-KEY      PIC X(5).
30     000390 05 REST-OF-RECORD    PIC X(75).
31     000400
32     000410 01 USER-QUITS-FLAG    PIC XXX VALUE "NO".
33     000420 88 USER-QUITS        VALUE "YES".
34     000430
35     000440 01 MORE-DATA-REMAINS-FLAG PIC XXX VALUE "YES".
36     000450 88 NO-MORE-DATA-REMAINS VALUE "NO".
37     000460 88 MORE-DATA-REMAINS  VALUE "YES".
38     000470
39     000480 01 REQUEST-KEY-MSG.
40     000490 05 FILLER          PIC X(40)
41     000500 VALUE "TYPE SELECTION KEY (OR Q TO QUIT)".
42     000510
43     000520 01 WAIT-MSG.
44     000530 05 FILLER          PIC X(40)
45     000540 VALUE "HIT <ENTER> TO CONTINUE".
46     000550 05 WAIT-CHAR      PIC X(2).
47     000560
48     000570 01 SELECT-KEY      PIC X(5).
49     000580
50     000590 EJECT
51     000600 PROCEDURE DIVISION.
52     000610
53     >0000 000620 RECORD-SELECTION-AND-DISPLAY.
54     >0000 000630 PERFORM GET-KEY-AND-SEARCH-FILE
55     000640 UNTIL USER-QUITS.
56     >000A 000650 STOP RUN.
57     000660
58     >000C 000670 GET-KEY-AND-SEARCH-FILE.
59     >000C 000680 DISPLAY REQUEST-KEY-MSG, LINE 2, ERASE.
60     >0014 000690 ACCEPT SELECT-KEY, POSITION 0, PROMPT, ECHO.
61     >001C 000700 IF SELECT-KEY = "Q"
62     000710 MOVE "YES" TO USER-QUITS-FLAG
63     000720 ELSE
64     000730 OPEN INPUT INFILE
65     000740 PERFORM SEARCH-FILE-AND-DISPLAY-RECORD
66     000750 UNTIL NO-MORE-DATA-REMAINS
67     000760 CLOSE INFILE
68     000770 MOVE "YES" TO MORE-DATA-REMAINS-FLAG
69     000780 DISPLAY WAIT-MSG
70     000790 ACCEPT WAIT-CHAR, POSITION 0, PROMPT, ECHO.
71     000800
72     >0050 000810 SEARCH-FILE-AND-DISPLAY-RECORD.
73     >0050 000820 READ INFILE INTO IN-RECORD
74     000830 AT END MOVE "NO" TO MORE-DATA-REMAINS-FLAG.
75     >0060 000840 IF MORE-DATA-REMAINS
76     000850 AND RECORD-KEY IS EQUAL TO SELECT-KEY
77     000860 DISPLAY IN-RECORD.
78     000870
79     000880 END PROGRAM.

```

sell more disk drives. [Editor's Note: Radio Shack replied saying that they have been using this same method of protecting their application software program files on all Model II software. They stressed that this does not represent a change in Tandy policy and emphasized that there are no restrictions on backups, only on copying individual files. . . .SJW]

For those who own disk editors such as Apparat's Superzap and are familiar with the disk-directory structure, it is a simple matter to overcome this problem by zapping the passwords. However, sensible use of the system should not be restricted to those with this knowledge.

## One of the biggest surprises was the introduction of a new version of DOS for the Model I.

On the positive side, all components of the RSCOBOL system appear to honor the high memory pointer address stored at location hexadecimal 4049. This is not documented, but by using a disassembler I found code referencing hexadecimal 4049 during the start-up phase of both the compiler and the run-time package in a manner that suggested it was using hexadecimal 4049 as a pointer to the top of available memory. I have also been using a serial printer driver that protects itself by storing the last available address below itself at hexadecimal 4049. I have experienced no difficulties with the use of this driver during compilation and execution of COBOL programs. If you have an application for this, I recommend careful testing to make sure that it works.

In case you haven't seen a reference to this before, most Model I DOS systems, including TRSDOS 2.3B, store a pointer at location hexadecimal 4049 to the last byte of available memory. Anything stored after the address contained in hexadecimal 4049 is "protected"; programs that follow this protocol, as RSCOBOL appears to, are careful not



## A Sample RSCOBOL Program

The sample RSCOBOL program shown in listing 1 prompts the user to type in a selection key (a string of up to five characters); it then reads through a sequentially organized disk file and compares the first five characters of each record in that file against the string typed in at the keyboard. All records whose first 5 bytes match the specified string are listed on the screen. This process is repeated until the user types Q instead of a key value.

The IDENTIFICATION DIVISION of the program, lines 1 through 7, is treated as a comment by the compiler. It tells the program's name, its author, and the date it was written.

The ENVIRONMENT DIVISION contains a CONFIGURATION SECTION. This identifies the SOURCE COMPUTER, or the system on which the program was compiled, as RMC (Ryan-McFarland COBOL). The OBJECT COMPUTER is the system on which the program will run; this is also RMC.

The INPUT-OUTPUT SECTION serves to establish connections between real disk file names and program identifiers for files. In this instance, line 17 logically connects the program file identifier INFILE with the TRSDOS file INFILE/DAT:1. A program variable could have been specified instead of the literal string INFILE/DAT:1, which would have allowed the file name to be specified at run-time rather than compile-time. The keyword INPUT specifies that this file is to be used for INPUT only.

The DATA DIVISION contains declarations for all program variables. Program variables in COBOL are referred to as "data items." The FILE SECTION contains a description of the disk records that will be read from the sequentially organized file INFILE. The WORKING-STORAGE SECTION contains declarations for all the program data items. IN-RECORD is the

name for the "group" data item comprising RECORD-KEY and REST-OF-RECORD. The clause PIC X(5) on RECORD-KEY declares that data item to be a 5-byte long string of alphanumeric characters. (PIC stands for PICTURE; X stands for a number or an alphabetical character.)

The data item USER-QUITS-FLAG in line 32 illustrates one of COBOL's powerful tools for enhancing program readability. This flag is a 3-byte character string (PIC XXX) that initially has the value "NO". USER-QUITS in line 33 is a "Level 88" item; it gives a name to a possible value of USER-QUITS-FLAG. In line 54 of the program, the statement PERFORM GET-KEY-AND-SEARCH-FILE UNTIL USER-QUITS serves to repeatedly perform the code paragraph labeled GET-KEY-AND-SEARCH-FILE until the USER-QUITS-FLAG assumes the value named by USER-QUITS, in this case the string "YES". MORE-DATA-REMAINS-FLAG is another example of the use of "Level 88" data items.

REQUEST-KEY-MSG and WAIT-MSG are data items containing prompts to be printed on the screen using the DISPLAY statement. The VALUE clause gives them initial values.

The PROCEDURE DIVISION of a COBOL program is where the work gets done. It is divided into "paragraphs," each labeled by a name starting in the second column. The first paragraph is named RECORD-SELECTION-AND-DISPLAY. It contains only two statements: one that has been explained already, and STOP RUN, which halts program execution and returns control to TRSDOS.

The next paragraph, labeled GET-KEY-AND-SEARCH-FILE, is the one PERFORMed repeatedly by the first paragraph. It clears the screen (ERASE) and puts the REQUEST-KEY-MSG on the second line of the screen.

It then ACCEPTs a user response from the keyboard, which goes into the data item called SELECT-KEY. POSITION 0 means leave the cursor where it is; PROMPT puts out a prompt of underscores the size of the data item SELECT-KEY; ECHO sends what is typed at the keyboard to the screen. The user is not allowed to type in more characters than will fit in the data item (one per underscore prompt character).

The IF statement in line 61 tests the value of SELECT-KEY typed by the user; if Q is typed, it puts the value "YES" in the USER-QUITS-FLAG. This causes termination of the program because the UNTIL USER-QUITS test in line 55 now evaluates as true.

If the user types anything other than Q, the ELSE part of the IF statement is executed starting at line 64. The file INFILE is opened for INPUT, and the paragraph SEARCH-FILE-AND-DISPLAY-RECORD is performed for each record in the file. When the file has been completely processed, it is closed in line 67, the flag MORE-DATA-REMAINS is reset to "YES" for the next time through the loop, and a message is displayed telling the user to hit the ENTER key to continue (lines 69 and 70).

The SEARCH-FILE-AND-DISPLAY-RECORD paragraph reads the next record from INFILE into the data item IN-RECORD. When the end of the file is reached, the word "NO" is put into the MORE-DATA-REMAINS-FLAG. This makes the test UNTIL NO-MORE-DATA-REMAINS in line 66 evaluate as true. If the end of the file is not reached, the RECORD-KEY field of the record read in from the file is compared to the SELECT-KEY typed in by the user. If they match, the entire record is displayed on the screen by the DISPLAY statement in line 77.

to use any memory past this point. This means that you can load any machine-language routines into high memory and set hexadecimal 4049 to point below them; the RSCOBOL system will not clobber your machine-language programs.

To give you a feeling for the

system, I will explain the procedure followed to create, compile, and run the COBOL program shown in listing 1. This is a short (by COBOL standards) program that searches a sequential disk file (very similar to a BASIC sequential file) for records whose key fields match the one typed

in at the keyboard. All matching records are displayed on the screen.

## COBOL Editor

To create a COBOL source program, some type of text editor must be used. If you are accustomed to full-screen editors, you will be disap-



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pointed with RSCOBOL's editor. Until there is a version of Scripsit or another full-screen editor that works with TRSDOS 2.3B, your only option is to use the line-oriented editor included with the RSCOBOL package. This editor, CEDIT, is written in assembly language. It is very similar to the original Model I EDTASM (Editor-Assembler) package, which in turn bears a close resemblance to the Level II BASIC editor. CEDIT does have a few enhancements, most noticeably the inclusion of a global "replace text" command. All CEDIT commands can be abbreviated to a single letter.

**If you are accustomed  
to full-screen editors,  
you will be  
disappointed with  
RSCOBOL's editor.**

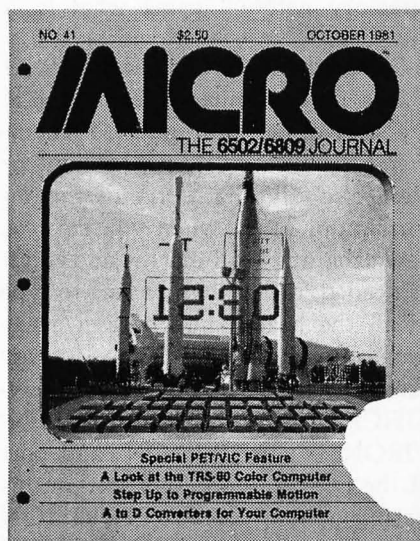
CEDIT loads all the text to be edited into memory and saves everything to disk at once. It is not a memory buffer editor, such as the one supplied with Radio Shack's FORTRAN package. Thus, you are restricted to editing files that will fit in memory all at one time. CEDIT saves COBOL source programs on disk in a plain ASCII format; blanks and line numbers are not compressed in any way.

If you look through the CEDIT portion of the RSCOBOL manual, do not be misled by the section titled "Source File Format" on page 3. It implies that each line of source code takes up its own 256-byte disk record. Fortunately, this is not true. Source code lines are packed together and terminated by carriage returns, as in most other TRS-80 editors. The entire file is terminated by a hexadecimal 1A byte.

When you are ready to use CEDIT to create a COBOL source program, you must decide which disks to put online. I have a disk that contains TRSDOS, CEDIT, and the RSCOBOL compiler. This disk goes into drive 0, and a blank disk in drive 1 holds the COBOL source code being edited. Decide in advance which disk



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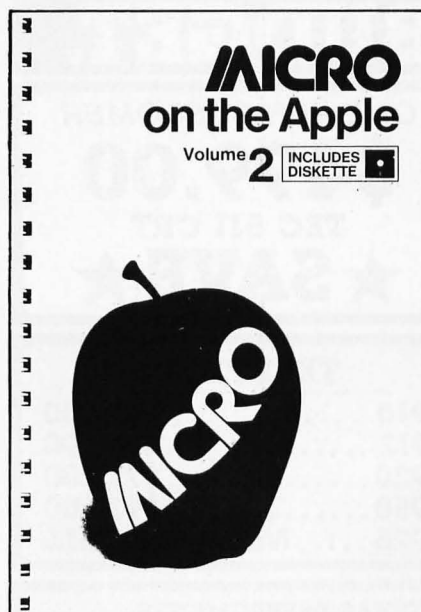
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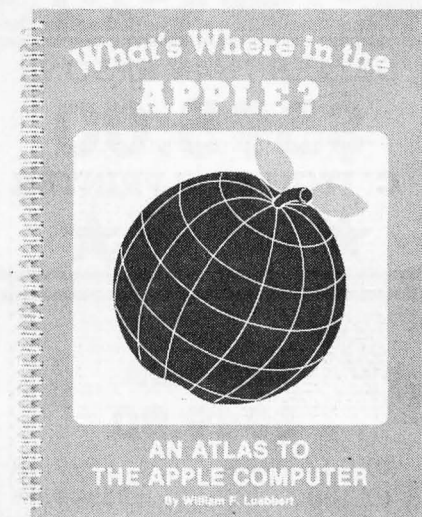
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will hold your COBOL program; once in the editor, you cannot go back to TRSDOS to look at the disk directory without losing what is in memory.

Since the COBOL language requires much similar information at the start of every program, I recommend that you create a "skeleton" or "template" file that contains this information. Then, when you create a new program, load this file and edit it as needed, rather than having to type in all the header information every time. Referring to listing 1, my skeleton file contains the IDENTIFICATION DIVISION, the ENVIRONMENT DIVISION, and part of the DATA DIVISION seen in this listing. My DATA DIVISION skeleton includes a FILE SECTION with a couple of FDs and the WORKING-STORAGE section with some often-used identifiers. Experience will help you decide which things are frequently repeated.

Line numbers are provided by the editor during the text creation process. The INSERT command, abbreviated I, is used much like BASIC's AUTO command; it automatically enters a line number, then you type the line. During text insertion, if the line number of a new line is the same as that of an existing line, the entire text is automatically renumbered from the current line to prevent overwriting the existing line. This gives you the advantage of never running out of room during text insertion. However, the disadvantage is that automatic renumbering causes the line numbers of existing lines to change. INSERT does not notify you that this has happened. This makes it more difficult to find and correct a line that was the cause of a compilation error, since error messages use the old line numbers. However, the offending line's contents are printed along with the error message. Therefore, you can use the editor's FIND command to locate the line.

FIND lets you search a range of source text for any string of characters. Another "new" command is CHANGE, which lets you change any string of characters to a different





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string in as many places as you want. This is useful if you discover that a data item name is a COBOL reserved word, e.g., KEY. KEY can be changed to RECORD-KEY in all lines of a program with the CEDIT command:

C/KEY/RECORD-KEY/\*

The "\*" means change KEY to RECORD-KEY everywhere it occurs in the program. A number N, instead of "\*", means change it the next N times it occurs. The "X" command behaves like CHANGE, but it asks you if the change should be made every time it finds a match for the search string.

Another useful command is MEMORY, which tells how big your program is in bytes and how much free memory is left.

CEDIT's remaining commands have counterparts in the Level II BASIC and EDTASM editors. These include commands to list a range of lines to the screen or printer, delete a range of lines, replace a range of lines, renumber the lines, and move to the top or bottom of the program file. The EDIT command provides editing of a single line; character insertion, deletion, and replacement; extension of the line, etc., in a manner nearly identical to Level II BASIC's EDIT command.

Once a program is completely typed in, it is saved to disk with the WRITE command. A default file name extension of /CBL is automatically provided. For example, typing W SAMPLE:1 saved the sample program's source file on drive 1 with a file name of SAMPLE/CBL.

## RSCOBOL Compiler

All the files in table 1 must be online before compilation begins. Several options are available at compile-time. I used the command:

RSCOBOL SAMPLE  
(P X L=1 O=1)

to compile the sample program. The options selected are printed at the top of each listing page. The P option means send a listing to the printer; an

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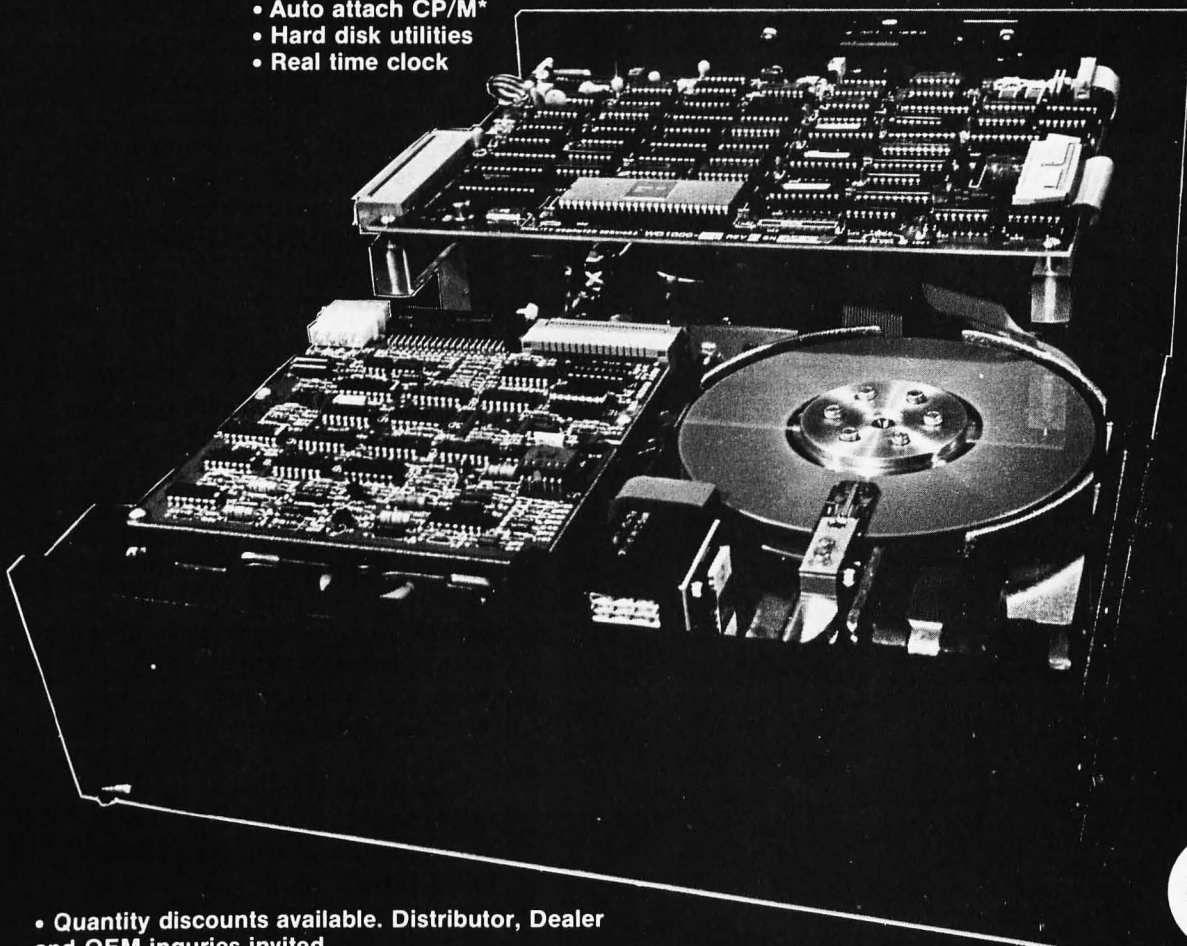
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sample is listing 1. The X option generates a cross-reference of PROCEDURE and DATA DIVISION names. This appears at the end of listing 1. The L=1 option sends a copy of the listing to a disk file on drive 1. O=1 means put the object file on drive 1. If O=N had been selected, no object file would have been created.

RSCOBOL provides a COPY statement that allows COBOL source files to be included directly from disk in the compilation of a program. For example, a common record definition could be kept in a file called RECDEF, and the source program statement COPY RECDEF would open that file and compile its contents just as if it were part of the main source file being compiled.

One problem with the implementation of COPY is that all COPY files must be online during compilation. If one of them is not, the compilation aborts with an error message. It would have been simple to have the compiler pause if the file were not found and ask the user to mount the disk containing the file instead of aborting the compilation. This would

have extended the size of source files that could be compiled for users with only two disk drives.

A couple of other options are available that were not used in the sample compilation. The D option compiles all the "debug" lines. Simply stated, any program line starting with D is ignored during compilation unless the D option is specified. Therefore, you can write your program with as much extra code as you want to help during debugging, and then have it all eliminated from the final version of your program by simply compiling without the D option. Debug code is commonly used to DISPLAY the value of some data item while testing a program. However, there is no restriction on the type of source code line that can be flagged in this way.

If the compiler finds any errors in your program, they are clearly marked with a pointer to the offending word and an error message in English. More than 70 error messages are possible, and I have never had a problem figuring out what they meant. Each error message has a brief explanation in the manual.

The compiler does not stop until it reaches the end of the source file, no matter how many errors it finds. This helps you to find as many errors as possible with a single compilation. If you specify the E option when you compile, only error messages are sent to the listing files. This is useful when compiling for the first time; you are likely to have some errors and can save wear and tear on your printer by printing only the error lines.

The T option directs the listing output to the screen. You can specify as many listing destinations as you wish—it is possible to direct output to a disk file, the printer, and the screen all at once. The sample program in listing 1 creates a disk file and a print-out at the same time.

As you can see from listing 1, the compiler provides a complete program listing. The date and time of compilation appear at the top of each page, along with the name of the source file and any options selected. The leftmost number in each line is a line number supplied by the compiler. The next column contains information needed when using the interactive debugger. Next is the editor line number, and then the source code line itself.

A summary of all program data items is provided in the order in which they were defined in the DATA DIVISION. Information provided for each data item includes from left to right:

- its address relative to the start of data storage, for use during debugging
- its size in bytes
- a three-character type code used during debugging; ANS = alphanumeric, GRP = group, etc. (there are 12 in all)
- the "Order," which is the number of subscripts a data item requires
- the data item type name in English
- the data item name

This listing is followed by the size of the read-only portion of the program (presumably the code block) in bytes, the size of the read/write portion (the data area) in bytes, and the

Listing 2: A summary of all data items from the program in listing 1.

```

TRS-80 Model I/III COBOL (RM/COBOL 1.3B) 08/17/81 08:30:52 PAGE 3
SOURCE FILE: SAMPLE OPTION LIST: (T X L=1 O=1)

ADDRESS  SIZE  DEBUG ORDER TYPE NAME
-----
>0000    80  ANS    0  FILE INFILE
      ALPHANUMERIC INFILE-RECORD
>0054    80  GRP    0  GROUP IN-RECORD
>0054     5  ANS    0  ALPHANUMERIC RECORD-KEY
>0059    75  ANS    0  ALPHANUMERIC REST-OF-RECORD
>00A4     3  ANS    0  ALPHANUMERIC USER-QUITS-FLAG
      CONDITION-NAME USER-QUITS
>00AB     3  ANS    0  ALPHANUMERIC MORE-DATA-REMAINS-FLAG
      CONDITION-NAME NO-MORE-DATA-REMAINS
      CONDITION-NAME MORE-DATA-REMAINS
>00AC    40  GRP    0  GROUP REQUEST-KEY-MSG
>00D4    42  GRP    0  GROUP WAIT-MSG
>00FC     2  ANS    0  ALPHANUMERIC WAIT-CHAR
>00FE     5  ANS    0  ALPHANUMERIC SELECT-KEY

READ ONLY BYTE SIZE = >0122
READ/WRITE BYTE SIZE = >0142
OVERLAY SEGMENT BYTE SIZE = >0000
TOTAL BYTE SIZE = >0264

0 ERRORS
0 WARNINGS

```



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For the sample program, a cross-reference table was requested. All PROCEDURE and DATA DIVISION names are listed in alphabetical order. For each entry, the line numbers in

The COBOL compiler resides from

If this should happen, the subroutine CALL can be used to alleviate the problem. A program can be split into a main program and subroutines, each separately compiled. At run-time, when the main program CALLs a subroutine, it is loaded dynamically from disk. This also provides a method for controlling memory usage at run-time. But it is not the only method. A single program can be broken into overlays. A program

```

TRS-80 Model I/III COBOL (RM/COBOL 1.3B)          08/17/81  08:30:52  PAGE   4
SOURCE FILE: SAMPLE                                OPTION LIST: (T X L=1 O=1

```

CROSS REFERENCE	/DECL/	*DEST*			
GET-KEY-AND-SEARCH-FILE	0054	/0058/			
INFILE	/0017/	/0022/	0064	0067	0073
INFILE-RECORD	/0024/				
IN-RECORD	/0028/	*0073*	0077		
MORE-DATA-REMAINS	/0037/	0075			
MORE-DATA-REMAINS-FLAG	/0035/	*0068*	*0074*		
NO-MORE-DATA-REMAINS	/0036/	0066			
RECORD-KEY	/0029/	0076			
RECORD-SELECTION-AND-DISPLAY	/0053/				
REQUEST-KEY-MSG	/0039/	0059			
REST-OF-RECORD	/0030/				
SEARCH-FILE-AND-DISPLAY-RECORD	0065	/0072/			
SELECT-KEY	/0048/	*0060*	0061	0076	
USER-QUITS	/0033/	0055			
USER-QUITS-FLAG	/0032/	*0062*			
WAIT-CHAR	/0046/	*0070*			
WAIT-MSG	/0043/	0069			



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segmented in this manner is compiled in one piece, but the overlays are loaded into memory dynamically at run-time when they are entered via a GOTO or PERFORM statement. These two options, CALL and overlays, combine to provide the most dynamic memory-management system that I have seen in any TRS-80 language.

A word on compiler performance. With both the input of source text and the output of object code involving disk I/O (input/output), and the compiler itself requiring several disk overlay loads during the course of a single compilation, this compiler is no speed demon. The sample program, with the options shown, took 135 seconds to compile. This works out to about 35 lines per minute. This includes printing a listing and creating a listing file on disk, both including cross-reference lists. Choosing options of T and E (create an object file on disk and print any errors on the screen), sped things up to about 50 lines per minute. It then took 95 seconds to compile the sample program.

### Testing a Program

The RSCOBOL system provides a simple run-time interactive debugger. This debugger allows you to test many aspects of a COBOL program without having to program in a lot of special debugging statements. Combined with the compiler's D option described earlier, RSCOBOL provides a decent debugging environment.

To make full use of the interactive debugger requires a current printed listing of the program under test. A printer is not a prerequisite for use of RSCOBOL, but I strongly recommend having one.

The command RUNCOBOL invokes the RSCOBOL run-time module. The debugger is invoked by specifying the D option. Once in the debugger, a COBOL program can be single-stepped a sentence or group of sentences at a time. This is achieved by typing S, optionally followed by N (where N is the number of sentences to execute). To execute all

the way up to a particular sentence, type A followed by the address in the DEBUG column preceding the sentence at which execution should stop.

The final debugger command is D. It is used to DUMP the contents of different data items in a readable format. For the sample program, by typing D 54, 5, ANS, the current value of the data item RECORD-KEY is displayed on the screen. It is permissible

---

## **A printer is not a prerequisite for use of RSCOBOL, but I strongly recommend having one.**

---

to request the display of a data item in other than the default format; a hexadecimal dump is available, for example.

Some important features that this debugger lacks include:

1. The capability to alter data item values.
2. A way of setting program breakpoints. The current system lets you specify that execution should proceed to a particular COBOL sentence; it is desirable to be able to specify a number of points in the code at which execution should halt, passing control to the debugger monitor.
3. A way to reference data symbolically rather than requiring the use of hexadecimal values representing actual data-storage locations.
4. A way to step through the statements of a COBOL sentence. In listing 1, there is only one value in the DEBUG column for the entire range of program lines from 61 to 71. This value represents the beginning of the COBOL sentence starting with "IF". You cannot step partially through this sentence; you must execute it in full.

If you are not using the debugger, the RSCBLD13/OBJ file need not be present during run-time.

### Run-Time Environment

The RSCOBOL package includes a substantial run-time module that must be resident during the execution of any COBOL program. The run-time code resides from locations hexadecimal 5200 to B1FF, leaving about 20K bytes of user program space. This is respectable for a small machine.

There is a trade-off in using a standard run-time module rather than linking in only those pieces specifically required by each program. Use of a run-time module allows much faster program development; the linking phase otherwise required is usually very time-consuming. It involves a lengthy search of a large library module to find those pieces required by a particular program. A run-time module also cuts down on the size of user programs; without one, every user program must contain a lot of the code that is otherwise in the run-time module, resulting in much duplicated code on a disk holding several user programs.

The disadvantage is that, in most cases, not all of the run-time code is needed for a particular program. Therefore, some memory space is taken up unnecessarily. RSCOBOL compensates for this somewhat with its overlay and CALL statements for memory management.

Two options besides D (invoke interactive debugger) are available at run-time:

1. S=nn.n: This option allows the setting of "switches" at run-time. A COBOL program can test for the value of these switches and make decisions accordingly. The eight switches each can assume the value 0 or 1.
2. T=hhhh: This sets the top memory address that will be used by RSCOBOL at run-time. It is used to protect user machine-language programs from the run-time system. As discussed previously, it appears that if your assembly-language program stores this value in location hexadecimal 4049 (for the Model I), the same effect is achieved.

Many English-language error



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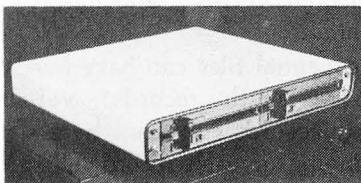


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BYTE March 1982 405



messages can appear at run-time. They are carefully documented in the RSCOBOL manual.

My overall impression of run-time performance is favorable. Every program I have written which reads from the disk, computes something, and writes the results to the printer has managed to keep the printer moving at full speed (60 characters per second bidirectional). Interpreted BASIC programs I have written, which perform similar formatted I/O with the PRINT USING statement, pause noticeably between the output of formatted data items. By comparison, RSCOBOL is quite snappy and moves right along.

### Language Implementations

RSCOBOL is based on the ANSI X3.23-1974 COBOL Standard. The ANSI Standard defines "levels" of implementation for different aspects of the language. Table 3 lists the levels of implementation provided by RSCOBOL. The more advanced the implementation, the higher the level number. The Federal Information Processing Standard (FIPS) lists 2 as a relatively "high" level of implementation for most language components. RSCOBOL's implementation does quite respectably.

Table 3 is somewhat misleading in that there are exceptions to the levels of implementation stated, i.e., certain features defined by ANSI as part of a level are not implemented. A complete list of these exceptions is in the

back of the RSCOBOL manual. Notable exceptions include:

- Multiple results are not supported in arithmetic statements. For example, you cannot state ADD A TO B C; you must state ADD A TO B and ADD A TO C.
- REMAINDER is not supported in the DIVIDE statement.
- INSPECT data items are restricted to a single character.
- Compound TALLYING and REPLACING clauses in the INSPECT statement are not supported.
- Exponentiation to a noninteger power is not supported.
- Abbreviated combined relation conditions are not supported. You cannot say IF A EQUALS 1 OR 2; you must say IF A EQUALS 1 OR A EQUALS 2.
- The STRING and UNSTRING statements are not supported.

Some extensions to the stated levels of implementation are available, mostly nonstandard. One that struck me as quite interesting was the inclusion of several statements having to do with the locking and unlocking of disk records. These statements allow simultaneous access to a disk file by multiple users in a controlled fashion.

It is worth mentioning that the rather powerful MOVE CORRESPONDING statement is implemented. This lets you move all like-named fields from one record to another with a single statement. MOVE CORRESPONDING is fre-

quently left out of small-machine implementations of COBOL. Also implemented are ADD CORRESPONDING and SUBTRACT CORRESPONDING.

The ACCEPT and DISPLAY statements provide good capabilities for interacting with the display and keyboard. In listing 1, the ACCEPT statement in line 60 puts out a field underscore characters the size of the data item SELECT-KEY, and allows only that many characters to be input. DISPLAY is a programmatically simple way of printing a data item's contents on the screen.

Assembly-language programs can be called from RSCOBOL. They are dynamically loaded from disk and must be in standard TRSDOS load format. An arbitrary number of parameters can be passed to an assembly-language program via the USING clause of the CALL statement. Parameters are passed by reference, i.e., the address of the data item itself is passed. This is a very flexible system. Loading assembly-language programs from disk at run time gives the same flexibility for managing memory used by assembly-language programs as for that used by COBOL subroutines.

### File I/O

COBOL probably has the most complete set of commercial file handling statements of any language. It is a substantial challenge to implement them for a 48K-byte RAM, dual floppy-disk Model I. RSCOBOL provides three major COBOL file types: sequential, relative, and indexed sequential.

Sequential files can have fixed- or variable-length records. Variable-length records contain a byte at the beginning of each record telling the length of that record. Lengths vary from 2 to 255 bytes. Fixed-length records do not contain any bytes telling the length. Sequential files, containing records of either type, must be accessed in order, that is, one record after the other in the order they were stored.

Relative or random files contain fixed-length records. Any particular

Function Module	Implementation
Nucleus	Level 2
Table Handling	Level 1 +
Sequential I/O	Level 2
Relative I/O	Level 2
Indexed I/O	Level 2
Sort-Merge	Null (nothing provided)
Report Writer	Null
Segmentation	Level 1
Library	Level 1
Debug	Nonstandard
Inter-program	
Communication	Level 1
Communication	Modified ACCEPT and DISPLAY for terminal communication

**Table 3:** Radio Shack COBOL's level of implementation as compared to the ANSI X3.23-1974 COBOL Standard.



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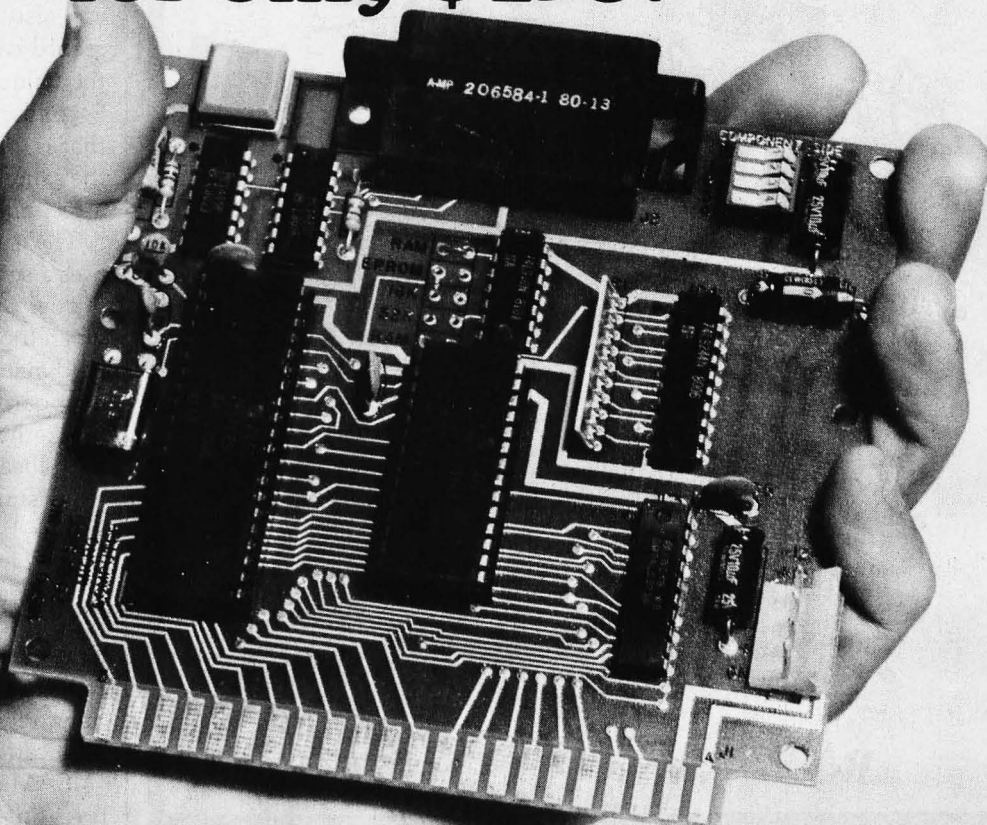
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record can be accessed "at random" by specifying its record number. The first record is number 1, the second number 2, etc. The maximum length of a relative record is 253 bytes.

Indexed sequential access method (ISAM) files are the most powerful ones provided by RSCOBOL. Records in an ISAM file are fixed-length, but can be up to 4096 bytes long. When creating an ISAM file, one or more "keys" must be specified. A key is simply a field of the record that is used later as a search argument over the file.

For example, an employee record may contain a Social Security number field. If this field is specified as a key when the file is created, you can later retrieve a particular employee's record by specifying the Social Security number. Such a method is usually easier to program than relative files, which require that you provide a record's number in order to directly retrieve it.

When an ISAM file is created, records are stored in sorted order on their "primary keys." The primary key must be guaranteed unique; the Social Security number is a good example of such a field. Secondary keys can also be specified for a record. A record can be retrieved by specifying the value of any secondary-key field. Secondary keys can have duplicates, that is, two or more records can have the same value in a field designated as a secondary key.

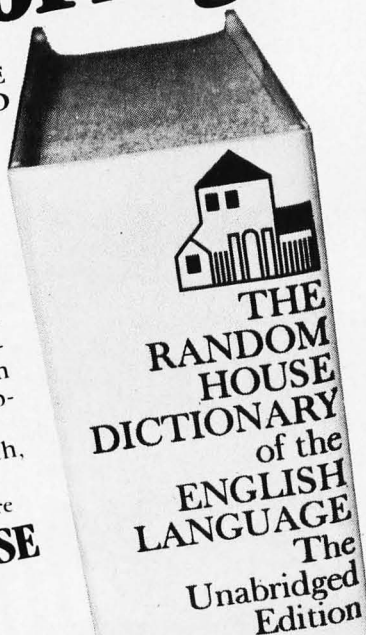
The sample program in listing 1 uses a sequential-type file, not ISAM. It does a sequential search of the file when looking for a record whose key field matches the value typed in at the keyboard. If an ISAM file had been used, the record desired could have been located directly by its key value.

In summary, the records of an ISAM file can be sequentially retrieved in the sorted order of any key field, and directly retrieved by specifying the value of a particular key field. This powerful access method reduces the amount of user programming required for many data-storage applications.

ISAM files do pay a space penalty for this generality in retrieving

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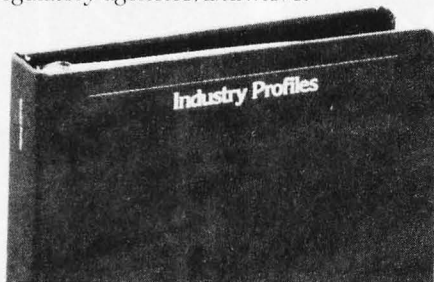
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records. An index structure is stored in the file for each field specified as a key. The manual states that the use of secondary (ALTERNATE) keys causes a geometric growth in the time required to create a file. However, the time required to access a record by its key is relatively uniform throughout the file.

The RSCOBOL manual gives the following formula for estimating the number of 256-byte sectors required for an ISAM file with the specified parameters:

$$\begin{aligned} \text{NRECS} = & \text{INT} ((S+33)/32) \times R/8 \\ & + (R \times 2)/\text{INT} (252/(Kn+8)) \quad \text{For each key} \\ & + (R \times D)/8 \quad \text{If duplicates are allowed} \end{aligned}$$

where R = maximum number of records desired

S = size of records in bytes

Kn = size of key n in bytes

D = number of keys that allow duplicates

I created an ISAM file containing one hundred 61-byte records, each containing a 5-byte primary key and no secondary keys. The input records used to create the file were read from a sequential file on disk. The ISAM file took 3 minutes and 40 seconds to create (2.2 seconds per record), and it used 37 sectors on the disk (8 grants). Since the formula predicts 35.5 sectors, it appears to be fairly accurate. A record file created by Disk BASIC would take 25 sectors (four records per sector) to hold this same amount of data. Therefore, the indexes do produce some overhead. Of course, you could not access the Disk BASIC records by key value, and this is the function you are buying with this extra disk space.

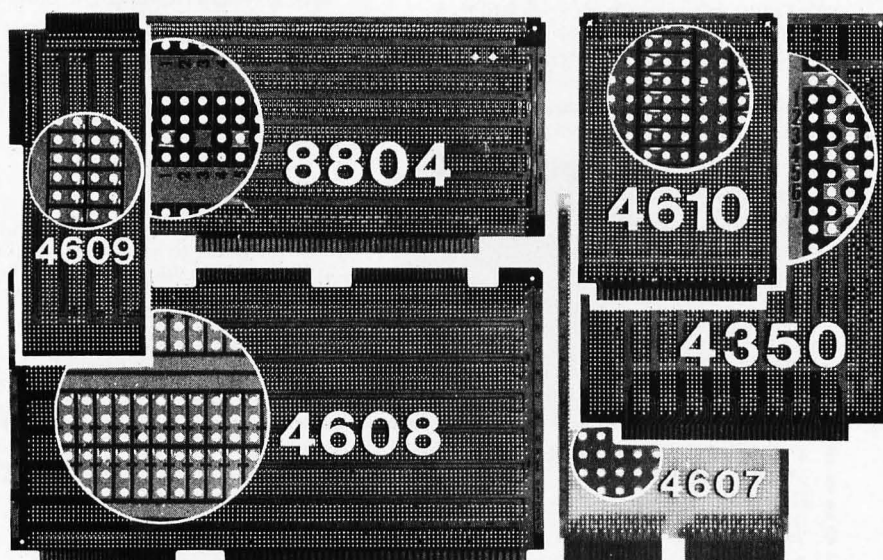
Performance wise, the disks kept spinning the whole time the ISAM file was being generated. An interpreted BASIC program creating a record file usually leaves the disks idling at intervals while it is performing computations. Two factors could further

speed up the file creation process. First, TRSDOS 2.3B steps my MPI disk-drive heads at a slow 40 milliseconds (ms) per track; they are capable of 5 ms per track. Second, I had the file of input records used to create the ISAM file on the same drive as the ISAM file itself. By placing these two files on separate drives, less disk-head movement would occur and the files would be accessed faster.

### Documentation

The manual accompanying RSCOBOL is a substantial one. It comes in a 3-inch-thick loose-leaf binder containing 368 offset-printed pages in a readable dot-matrix font. This is definitely not a beginner's guide; a good COBOL textbook is a necessity if you have not used the language much. If you are already familiar with COBOL, however, you will find complete information about every aspect of RSCOBOL, written in the style of a reference manual.

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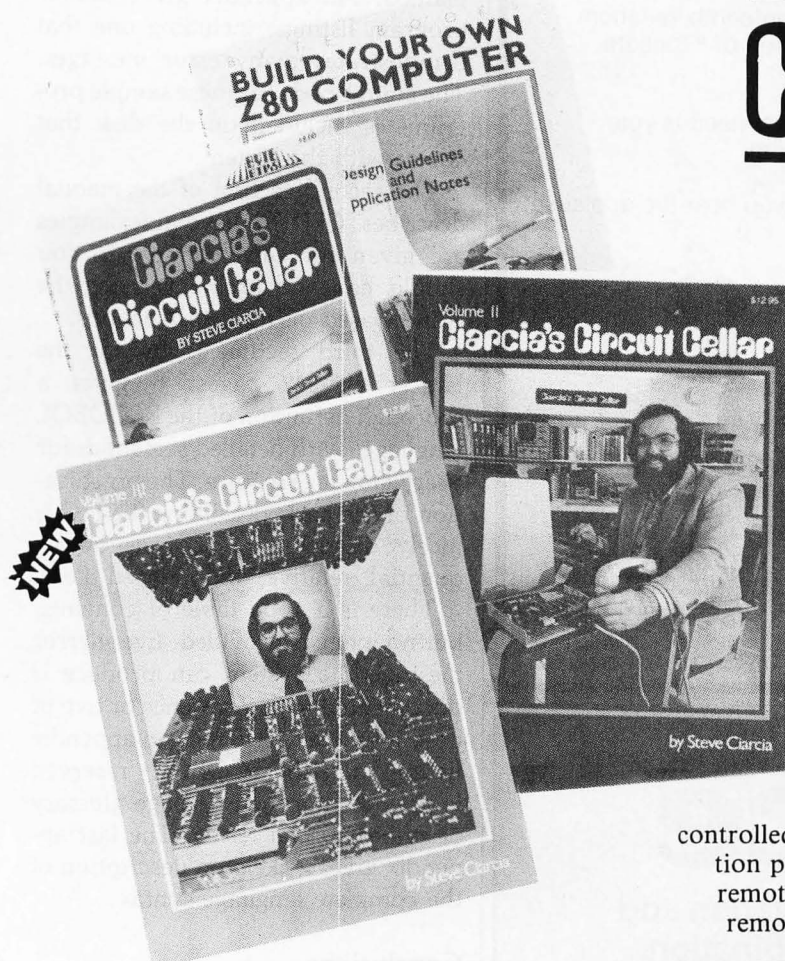
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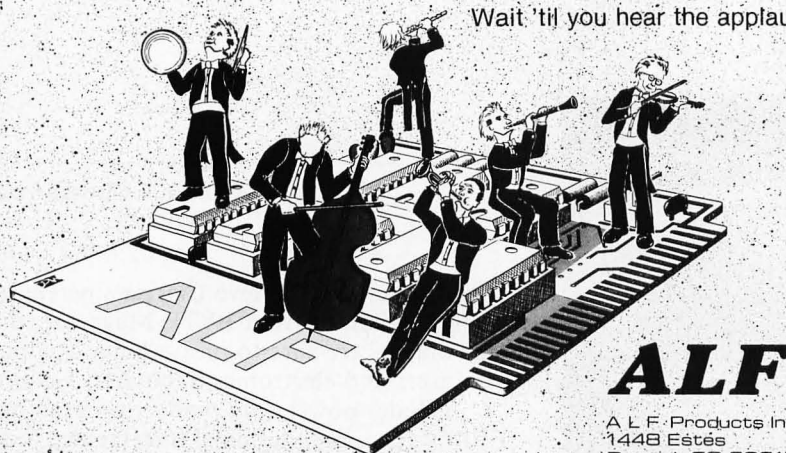
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The first section describes the use of the system, including discussions on how to use the compiler, the run-time module, and the interactive debugger. Compile-time and run-time error messages are listed and explained. An appendix gives sample program listings, including one that demonstrates many error messages. The source code for these sample programs is included on the disk that comes with the system.

The second section of the manual describes CEDIT. Several examples are given for each command. You should have no problems using the editor based on these instructions.

The third section is by far the largest at 297 pages. It gives a thorough definition of the RSCOBOL language, with detailed semantics for every language feature. The organization of the parts discussing file I/O is nicely divided into sections on sequential, relative, and indexed files.

There is a good table of contents, but no index is provided. Every error message the system can produce is documented with a sentence or two of descriptive text. There is an appendix listing all the COBOL reserved words. A thorough 24-page glossary describes special terms. The last appendix gives a skeleton description of the complete language syntax.

## Conclusions

Radio Shack has provided a very complete, professionally done COBOL package. The memory-management options do almost everything possible to compensate for the inherent limits of the Model I and III machines—a small main memory of 48K bytes and limited floppy-disk storage. The most powerful features of this system, especially the multi-keyed ISAM files, are limited by the floppy-disk system for anything but the smallest applications. Use the formula given earlier for computing disk-space requirements and make sure your application will fit before you invest in this software. However, if you just want to learn how to program in COBOL and you already have the hardware, this is an excellent package. ■



# 1 Infinity:

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### Inversions

An "inversion" is a word that has been written so that it reads symmetrically.

For instance, words that are the same upside down and right side up are inversions. A few words exist in the English language that do this naturally, such as "SWIMS" and "NOON." But alas, the great majority of words, when turned upside down, don't do anything interesting at all.

Fortunately for lovers of inversions, letters are quite flexible. Look around you and you will see the letter "a" written in hundreds

of different ways. And all of them we have learned to read as the same letter.

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In the accompanying text, Scott explains how inversions are created, so that you may try your hand at them.

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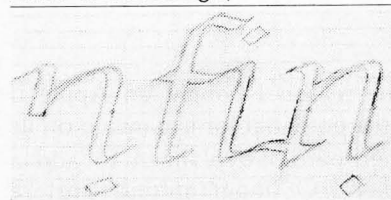
— Martin Gardner,  
**Scientific American**

### Infinity



### Infinity

In this design, Scott Kim mixes idea and image, art and technology, in a swirling evocation of infinity. This intricate design was created with the aid of a computer program, which took a basic hand-drawn design,



repeated it symmetrically,



then bent it into a continuously expanding spiral.

As you look at the design, you'll discover that it can be read in two different ways. Notice that the letters "fi" when turned upside down become the "y" at the end of "infinity." And so the spiral can be read as either "infinity" going in or "infinity" coming out! Which do you see?

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## John Bell Engineering's Apple II Parallel Interface Board

---

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---

One reason I bought an Apple II was the potential for expansion on its motherboard. I'd planned to add a parallel I/O (input/output) port, a real-time clock, and a couple of other items I was going to design and build. After working with the board for two years, though, I concluded that buying one that already had these features would put me ahead of the game.

Fortunately, I discovered that John Bell Engineering produces an Apple II parallel interface board—actually a multifunction module. It contains two 6522 Versatile Interface Adapters (VIAs) and can function as a parallel interface, clock, or counter. To explain the capabilities of the card, I need only elaborate on the capabilities of the 6522 chip.

### About the Author

*Ned Rhodes earned a BEE from the University of Minnesota and a master's in computer science from George Washington University. He presently develops minicomputer-based distributed processing systems for the MELPAR division of E-Systems Inc. in Falls Church, Virginia.*

### The 6522 VIA

The 6522 is a 40-pin support chip compatible with the 6502 microprocessor family. The chip is designed for connection to the data and address bus of a 6502 microprocessor, and it provides two bidirectional, 8-bit I/O ports (where the direction of each bit is programmable). In addition

to the parallel ports, each 6522 has two 16-bit, fully programmable clocks that can be used as counters or interval timers. The chip also includes a shift register for use with one of the timers to clock serial data into or out of the 6522. Each 6522 fully supports the 6502 interrupt structure, finally allowing you to constructively use

### At a Glance

#### Name

Apple II Parallel Interface

#### Use

Board may be used for parallel I/O, timing, or serial-to-parallel/parallel-to-serial conversions

#### Manufacturer

John Bell Engineering  
POB 338  
Redwood City, CA 94064  
(415) 367-1137

#### Dimensions

3 inches by 5 (7.5 by 12.5 cm); plugs into any Apple slot

#### Price

Assembled, \$69.95; kit, \$59.95; board only, \$22.95

#### Features

Board contains two 6522 Versatile Interface Adapters with a total of four 8-bit, bidirectional I/O data ports; eight I/O control lines; four independent, 16-bit timers; and two 8-bit, serial-to-parallel/parallel-to-serial shift registers. User can choose the IRQ or NMI interrupt lines

#### Software Needed

All user-written—no software provided

#### Documentation

A 16-page booklet containing a circuit board description and a 6522 data sheet

#### Audience

Assembly-language programmers and others with some hardware experience



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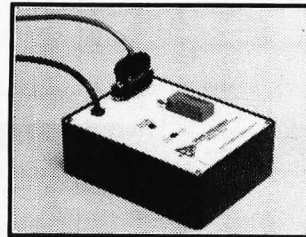
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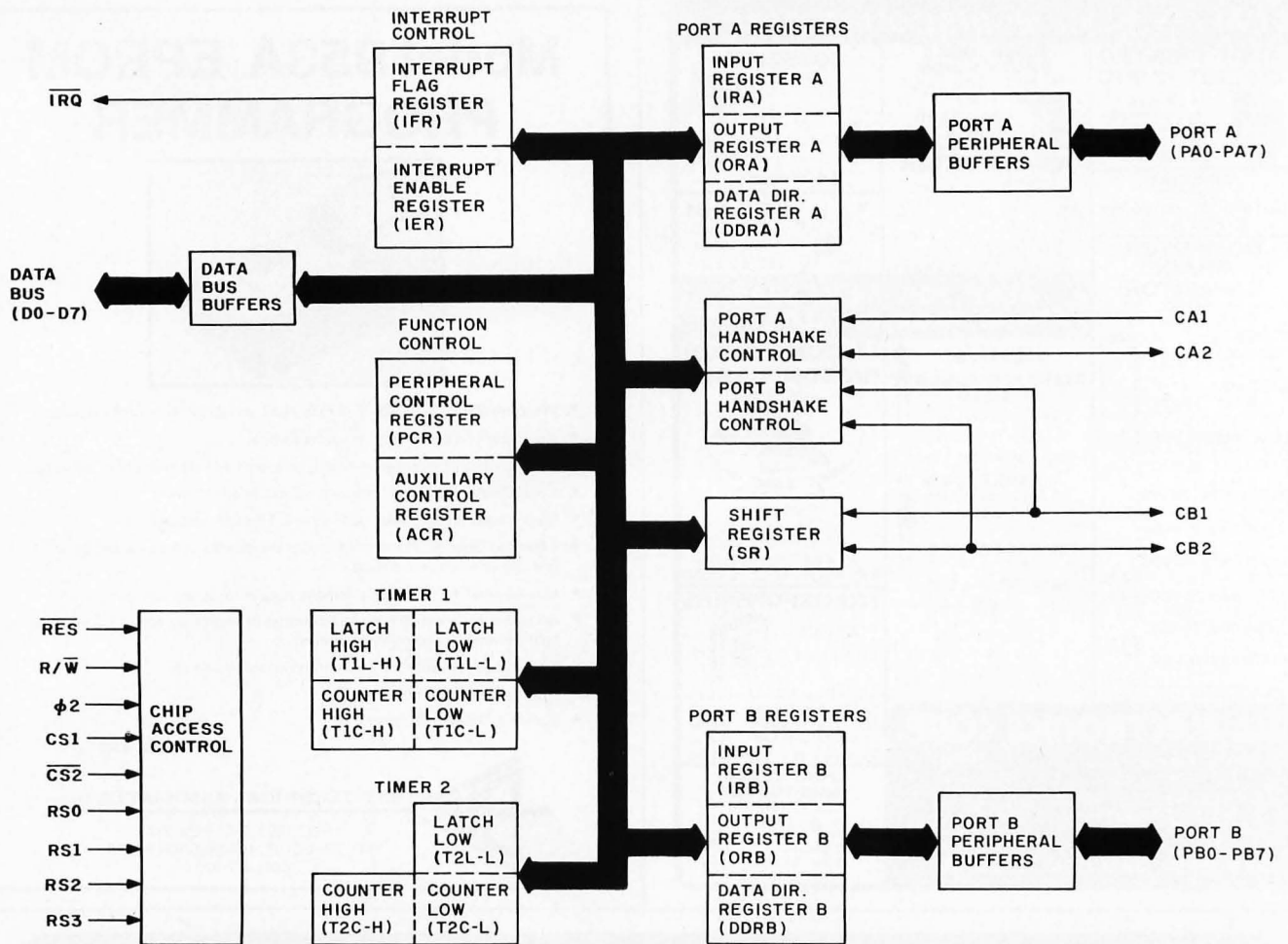


Figure 1: Block diagram of the internal configuration of the 6522 VIA (Versatile Interface Adapter) integrated circuit.

the Apple interrupts.

All communication with the 6522 occurs through 16 internal registers. Two of the 16, IRB/ORB and IRA/ORA, are used as I/O registers for the two 8-bit parallel ports. Two others, DDRB and DDRA, are data-direction registers that define the direction of each bit (either input or output) of the parallel ports. Four registers are set aside to control the two programmable counter/timers, and one I/O register controls the serial-shift register. Two registers select the operating mode of the timers and shift register; they also determine whether the chip will recognize positive- or negative-going control pulses.

The 6522 has a dedicated interrupt flags register that allows the chip to generate interrupts upon detection of

(1) a positive- or negative-going edge on any of the four control lines, (2) a timeout (overflow) condition on either of the timers, or (3) the completion of a shift-register shift cycle. One register selectively enables and disables interrupt generation, while the last register is reserved for special forms of I/O through port A. Figure 1 is a block diagram of the 6522 chip's internal layout.

### 6522 on the Apple

Due to a design limitation in the Apple II, the 6522 can't work properly if it's merely attached to the bus; the 6522 requires a phase 2 clock pulse that isn't available on the Apple. The Apple 6502 processor generates the phase 2 clock signal, but that pin is unavailable at the expansion slot connectors.

Therefore, the I/O board must gen-

erate its own phase 2 clock signal. The phase 2 clock pulse is simulated by delaying the phase 0 clock signal by 80 nanoseconds. I must point out that simply delaying phase 0 may not match the duty cycle specification of the phase 2 clock, but that doesn't seem to matter. The 6522s accept the simulated phase 2 clock signal and work just fine.

### The Circuit Board

The board may be purchased in three different forms. For those of you with no hardware experience, it's available as a fully assembled and tested card. It may also be bought as a complete kit or as a bare board for which you supply the parts. I chose the bare board, then ordered the sockets and 6522 chips from a mail-order supplier.

The board is very simple to build.



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All you do is mount two 40-pin sockets, four 16-pin sockets, one 14-pin socket, and two bypass capacitors. Then plug in the chips and you're ready to go. The documentation suggests that you use "standard assembly and soldering techniques." I guess that means you shouldn't lift the solder donuts by applying excessive heat and that solder bridges between pins are taboo. I managed to avoid both perils.

Connections are made through the four 16-pin DIP (dual in-line package)

sockets; each socket handles eight bits. If interrupts are used, two jumper wires must be installed to enable them. One of the 6522s can be attached to the IRQ (interrupt-request) line, while the other can be attached to the NMI (nonmaskable interrupt) line. Note that the interrupt lines *cannot* be shared—you can have only one 6522 attached to an interrupt line.

Documentation accompanying the board is sparse, and the unadventurous user may get lost. The board

comes with a two-page circuit diagram and register identification list, a two-page circuit description and a two-page list of all possible board addresses (whose availability depends upon which slot is used in the Apple). A ten-page 6522 data sheet is also provided.

If you can read the data sheet, you can use the 6522. If you find the data sheet difficult to understand, chances are this product isn't for you. The manufacturer has provided no software examples because of "the numerous uses of the board." I believe that limits the board's usefulness. Hold on, though; I've provided two software routines to demonstrate the capabilities of the parallel interface board and the 6522s.

### Software

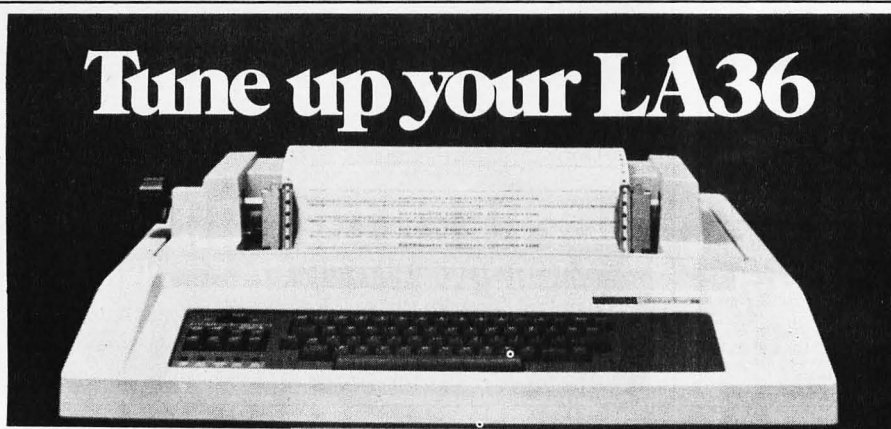
I was unable to write software that would test *all* of the 6522 functions, so I chose two of the more common applications: parallel I/O and clock

*Parallel Printer Routine.* The first software example, in listing 1, is a parallel output routine for a printer such as the Epson MX-80. Two basic sections comprise the routine. In the first section, the output routine is "hooked" through DOS, so that all character output to the screen will also appear on the printer. The horizontal-tab counter and the screen-echo flag are initialized at this time. The 6522 is then set up for output, and a Control X is sent to the printer, clearing its internal buffer. In the routine's second section, the characters are output, one at a time to the printer.

The 6522 initialization is unique. First, you enable port A for output by placing a hexadecimal FF in the data direction register (DDRA) for port A. Then set up the data-output strobe and the data-ready flag, which are the handshaking signals required for parallel communications. When the printer is ready to receive data, it indicates this with a pulse. With the MX-80, a negative-going pulse indicates ready, so you tie it to the C line (one of the control lines for port A). The other signal, the data strobe

*Text continued on page*

## Tune up your LA36

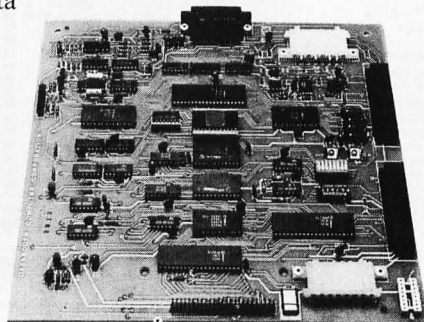


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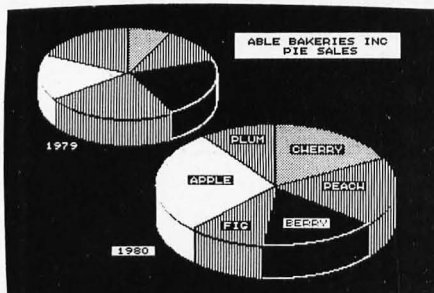
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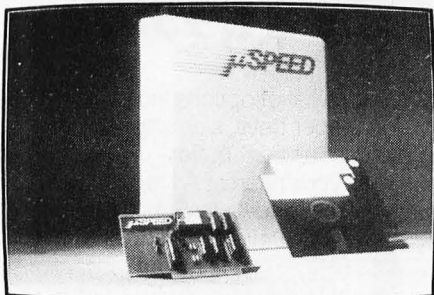
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**Listing 1:** Parallel printer output routine for the John Bell Engineering parallel board. Written in 6502 assembly language, this program is designed to drive an Epson MX-80 printer.

```

1000 *
1010 *
1020 * MX-80 PRINTER DRIVER
1030 * DJG 3/81
1040 * MODIFIED BY NWR FOR USE WITH JOHN BELL CARD
1050 *
1060 * NORMAL MODE ECHOES ON SCREEN
1070 * CNTL-H (BACK ARROW) ABORTS SCREEN ECHO SO
1080 * BASIC LISTINGS WILL USE FULL 80 COLUMNS
1090 * CNTL-G (BELL) IS ALWAYS SENT TO SCREEN ONLY
1100 *
1110 *
1120 * 6522 REGISTER EQUATES
1130 *
1140 *
1150 SLT1 .EQ $C300    SLOT 3 6522 REGISTERS
1160 DRA .EQ SLT1+1    OUTPUT REGISTER A
1170 DDRA .EQ SLT1+3    DATA DIRECTION REGISTER
1180 PCR .EQ SLT1+$C    PERIPHERAL CONTROL REGISTER
1190 IFR .EQ SLT1+$D    INTERRUPT FLAG REGISTER
1200 *
1210 *
1220 * PROGRAM EQUATES
1230 *
1240 *
1250 CH .EQ $24        SCREEN HOR. CURSOR POSITION
1260 HCNT .EQ $0479    CHARACTER COUNTER IN SLOT 1 RAM
1270 FLAG .EQ $04F9    FLAG FOR ECHOING ON SCREEN
1280 ACC .EQ $0579    ACCUMULATOR STORAGE
1290 ENBL .EQ $11       ENABLE PRINTER CHARACTER
1300 CNTX .EQ $152     CONTROL X CHARACTER
1310 SCRNL .EQ $FDF0    SCREEN SUBROUTINE
1320 DHOK .EQ $36      OUTPUT HOOK LOCATION
1330 HOOK .EQ $3EA     DOS HOOK ROUTINE
1340 BELL .EQ $87      BELL CHARACTER
1350 SLNT .EQ $8       CONTROL-H ECHO ON PRINTER ONLY
1360 CAR .EQ $D        CARRIAGE RETURN
1370 SPAC .EQ $A0      SPACE CHARACTER
1380 *
1390 *
1400 * .OR $0300    START IT HERE
1410 * .TF MX80.BELL.OBJ
1420 *
1430 *
1440 * MX80 INITIALIZATION
1450 *
1460 * CALL THIS PORTION OF THE ROUTINE TO
1470 * SET UP THE PRINTER DRIVER TO SEND
1480 * CHARACTERS TO THE PRINTER
1490 *
1500 *
1510 MX80 LDA #$FF    SET PORT A FOR
1520 STA DDRA    OUTPUT
1530 LDA #$0A    CA1 ON NEGATIVE EDGE
1540 STA PCR     CA2 GIVES PULSE
1550 LDA $ENBL   ENABLE PRINTER (SO IFR1 WILL
1560 STA DRA     BE SET FOR FIRST CHARACTER)
1570 LDA $CNTX   CNTL X ERASES BUFFER
1580 STA ACC     SAVE IT
1590 JSR POUT    SEND IT
1600 LDA $PRNT   ADDRESS OF NEW OUTPUT ROUTINE
1610 STA DHOK    SAVE IT
1620 LDA $PRNT   ADDRESS OF NEW OUTPUT ROUTINE
1630 STA DHOK+1  SAVE IT
1640 JSR HOOK    HOOK NEW OUTPUT ROUTINE TO DOS
1650 LDA $00     GET INITIAL VALUE
1660 STA HCNT    ZERO HORIZONTAL CHARACTER POSITION
1670 STA FLAG    SCREEN ECHO ON
1680 RTS        DONE WITH INITIALIZATION
1690 *
1700 *
1710 * OUTPUT ROUTINE
1720 *
1730 *
1740 PRNT CMP $BELL    A BELL CHARACTER??
1750 BEQ TV     YES, AVOID PRINTER'S RACKET
1760 AND #$7F   REMOVE MSB
1770 PHA        SAVE ACCUMULATOR
1780 CMP $SLNT  DISABLE SCREEN ECHO??
1790 BNE CR     NO
1800 STA FLAG   PUT NON-ZERO IN FLAG
1810 CMP $CAR   CARRIAGE RETURN?
1820 BNE TAB   NO
1830 LDA #$FF   COUNTER WILL BE ZERO AFTER CR
1840 STA HCNT   RELOAD HORIZONTAL CHARACTER-1
1850 LDA HCNT  COMPARE COUNTER WITH SCREEN
1860 CMP CH    HOR. POSITION
1870 BCS CHAR  BRANCH IF IN PROPER POSITION
1880 *
1890 *
1900 * OUTPUT SPACES UNTIL PRINTER IS AT THE PROPER
1910 * HORIZONTAL CHARACTER POSITION
1920 *
1930 *
1940 LDA $SPAC   GET A SPACE
1950 STA ACC    SAVE AS PRINT CHARACTER
1960 JSR POUT   PRINT IT
1970 JMP TAB   CHECK HOR. POSITION AGAIN
1980 PLA      GET CHARACTER
1990 STA ACC   SAVE AS PRINT CHARACTER
2000 JSR POUT  GO PRINT IT
2010 LDA FLAG  ECHO ON SCREEN?
2020 BNE RET   NO

```

Listing 1 continued on page 422

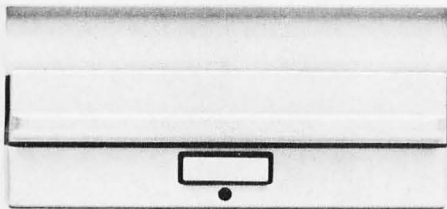




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SN7414N	20	SN7489N	60	74S20	55	74S201	675
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SN7420N	17	SN7492N	60	74S30	75	74S251	275
SN7425N	20	SN7493N	60	74S37	55	74S287	295
SN7430N	17	SN7494N	60	74S50	65	74S288	295
SN7437N	26	SN7495N	60	74S51	69	74S299	575
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74LS03	28	74LS162	80	74LS03	38	74LS158	75
74LS04	28	74LS163	98	74LS04	39	74LS174	135
74LS05	22	74LS164	65	74LS06	39	74LS175	135
74LS06	29	74LS165	66	74LS10	39	74LS182	75
74LS08	28	74LS166	155	74LS15	45	74LS189	425
74LS10	26	74LS170	175	74LS20	55	74LS201	675
74LS12	26	74LS171	175	74LS22	55	74LS240	275
74LS14	22	74LS174	85	74LS24	75	74LS244	295
74LS16	26	74LS175	85	74LS30	75	74LS251	275
74LS18	26	74LS190	85	74LS37	55	74LS287	295
74LS20	22	74LS191	125	74LS50	65	74LS288	295
74LS22	27	74LS192	95	74LS51	69	74LS299	575
74LS24	31	74LS193	95	74LS54	65	74S470	925
74LS26	40	74LS194	125	74S74	65	74S471	950
74LS28	37	74LS197	78	74S86	95	74S473	950
74LS30	29	74LS221	125	74S112	195	74S474	950
74LS32	31	74LS240	165				
74LS34	31	74LS241	165				
74LS36	31	74LS242	155				
74LS38	31	74LS243	155				
74LS40	31	74LS244	155				
74LS42	63	74LS245	245				
74LS44	77	74LS246	245				
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74LS172	50	74LS310	245				
74LS174	50	74LS311	245				
74LS176	50	74LS312	245				
74LS178	50	74LS313	245				
74LS180	50	74LS314	245				
74LS182	50	74LS315	245				
74LS184	50	74LS316	245				
74LS186	50	74LS317	245				
74LS188	50	74LS318	245				
74LS190	50	74LS319	245				
74LS192	50	74LS320	245				
74LS194	50	74LS321	245				
74LS196	50	74LS322	245				
74LS198	50	74LS323	245				
74LS200	50	74LS324	245				
74LS202	50	74LS325	245				
74LS204	50	74LS326	245				
74LS206	50	74LS327	245				
74LS208	50	74LS328	245				
74LS210	50	74LS329	245				
74LS212	50	74LS330	245				
74LS214	50	74LS331	245				
74LS216	50	74LS332	245				
74LS218	50	74LS333	245				
74LS220	50	74LS334	245				
74LS222	50	74LS335	245				
74LS224	50	74LS336	245				
74LS226	50	74LS337	245				
74LS228	50	74LS338	245				
74LS230	50	74LS339	245				
74LS232	50	74LS340	245				
74LS234	50	74LS341	245				
74LS236	50	74LS342	245				
74LS238	50	74LS343	245				
74LS240	50	74LS344	245				
74LS242	50	74LS345	245				
74LS244	50	74LS346	245				
74LS246	50	74LS347	245				
74LS248	50	74LS348	245				



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XASM09 ..... 6809  
XASM18 ..... 1802  
XASM48 ..... 8048/8041  
XASM51 ..... 8051  
XASM65 ..... 6502  
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## Listing 1 continued:

```
0360- AD 79 05 2030 LDA ACC GET CHARACTER AGAIN
0363- 09 80 2040 ORA #80 SET MSB FOR SCREEN
0365- 4C F0 FD 2050 TV JMP SCRN OUTPUT TO SCREEN
0368- 60 2060 RET RTS NORMAL RETURN
      2070 *
      2080 *
      2090 * POUT SUBROUTINE
      2100 *
      2110 * HANDLES OUTPUT TO PRINTER
      2120 * CHARACTER TO BE PRINTED IS IN ACC
      2130 *
      2140 *
0369- A9 02 2150 POUT LDA #02 LOAD COMPARE MASK
036B- 2C 0D C3 2160 BIT IFR IS PRINTER READY??
036E- F0 F9 2170 BEQ POUT NO, WAIT
0370- AD 79 05 2180 LDA ACC GET CHARACTER TO PRINT
0373- 8D 01 C3 2190 STA ORA PRINT IT
0376- EE 79 04 2200 INC HCNT BUMP CHAR. COUNTER
0379- 60 2210 RTS RETURN
      2220 .EN
```

## SYMBOL TABLE

```
0579- ACC
0087- BELL
0000- CAR
0024- CH
0354- CHAR
0098- CNTX
0339- CR
C303- DDRA
0036- DHOK
0011- ENBL
04F9- FLAG
0479- HCNT
03EA- HOOK
C30D- IFR
0300- MX80
C301- ORA
C30C- PCR
0367- POUT
032B- PRNT
0368- RET
F0F0- SCRN
0008- SLNT
C300- SLT1
00A0- SPAC
0342- TAB
0365- TV
```

Listing 2: This routine uses the parallel board as a real-time clock. The time will be continuously displayed on the screen.

## \*\*\* SYNTAX ERROR

:ASM

```
1000 *
1010 *
1020 *
1030 * DOSCLOCK -- REAL TIME CLOCK WITH CORRECTION
1040 * FOR DISK USE. THIS PROGRAM USES THE JOHN BELL
1050 * ENGINEERING PARALLEL BOARD AS A REAL TIME DIGITAL
1060 * CLOCK.
1070 *
1080 * NOTE -- THIS ROUTINE IS ASSEMBLED TO START NEAR
1090 * THE END OF THE INPUT LINE BUFFER. THIS MEANS THAT
1100 * YOU WILL NOT BE ABLE TO ENTER REALLY LONG LINES
1110 * OF TEXT. THIS ROUTINE IS NOT COMPATIBLE WITH
1120 * THE PROGRAM LINE EDITOR BECAUSE THAT PROGRAM USES
1130 * LOCATION $45 WHICH IS WHERE THE MONITOR STUFFS
1140 * THE ACCUMULATOR DURING INTERRUPT PROCESSING.
1150 *
1160 * BECAUSE THE 6522 IS ATTACHED TO THE APPLE
1170 * BUSS, THE PUSHING OF THE RESET BUTTON WILL RESET THE
1180 * 6522 AS WELL AS THE APPLE. THAT MEANS THAT YOU WILL
1190 * HAVE TO RESTART THE CLOCK EVERY TIME RESET IS PUSHED.
1200 *
1210 * IN ORDER TO USE THIS ROUTINE WITH THE JBE BOARD, YOU
1220 * HAVE TO ENABLE TIMER T2 TO COUNT THE NUMBER OF TICKS
1230 * OF TIMER T1. THIS IS ACCOMPLISHED BY JUMPING PINS
1240 * 7 AND 8 ON J2 TOGETHER
1250 *
1260 *
1270 * RAM VERSION FOR SLOT 3
1280 *
1290 * DJG 4/81 (DERIVED FROM AN ATM CLOCK ROUTINE
1300 * BY DEJONG IN MICRO)
1310 * NWR 8/81 (MODIFIED FOR SLOT 3 AND THE
1320 * JBE PARALLEL BOARD)
1330 *
1340 *
1350 * PROGRAM ADDRESSES:
1360 *
1370 * ENTRY POINT (TO START CLOCK):
1380 * $0280 (CALL 640)
1390 *
1400 * TO CONTROL SCREEN TIME DISPLAY:
1410 * $77F (POKE 1919,X)
1420 * (NON-ZERO VALUE DISPLAYS TIME CONTINUOUSLY)
1430 *
1440 * TO STOP CLOCK:
1450 *
1460 * LOAD LOCATION $C30E WITH $40
1470 * (POKE -15602,64)
1480 *
1490 *
```

Listing 2 continued on page 424



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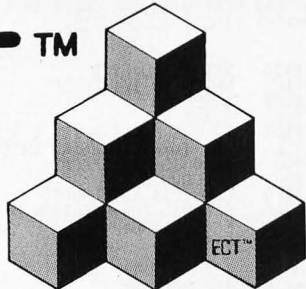
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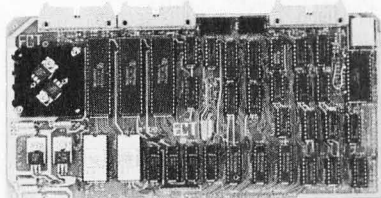
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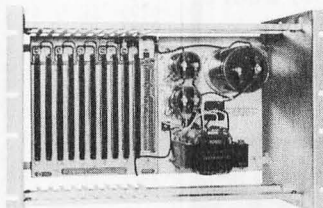
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Listing 2 continued:

```

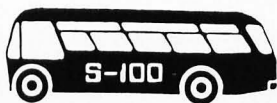
1500 *      PROGRAM EQUATES
1510 *
1520 *
0045- 1530 ACC .EQ $0045  MONITOR SAVE ACC HERE ON IRQ
0420- 1540 SCR. .EQ $0420  RIGHT HAND TOP LINE OF SCREEN
047F- 1550 FREE .EQ $047F  SLOT 7 SCRATCH RAM -- SEE APPLE REFERENCE MANUAL
047F- 1560 FRAC .EQ FREE  INTERRUPT COUNTER
04FF- 1570 SEC .EQ FREE+$80  SECONDS COUNTER
057F- 1580 MIN .EQ FREE+$100  MINUTES COUNTER
05FF- 1590 HOUR .EQ FREE+$180  HOURS COUNTER
067F- 1600 TMPL .EQ FREE+$200  TEMP STORAGE
06FF- 1610 TMPL .EQ FREE+$280  TEMP STORAGE
077F- 1620 FLAG .EQ FREE+$300  DISPLAY FLAG
03FE- 1630 IRQV .EQ $03FE  IRQ VECTOR
1640 *
1650 *
1660 *      6222 REGISTER EQUATES
1670 *
1680 *
C300- 1690 DS1 .EQ $C300  SLOT 3 6522 ADDRESSES
C300- 1700 PB .EQ DS1    PORT B
C304- 1710 T1L .EQ DS1+4  TIMER 1 LOW LATCH
C305- 1720 T1H .EQ DS1+5  T1 HIGH
C309- 1730 T2L .EQ DS1+8  TIMER 2 LOW LATCH
C309- 1740 T2H .EQ DS1+9  T2 HIGH
C30B- 1750 ACR .EQ DS1+$B  CONTROL REG
C30D- 1760 IFR .EQ DS1+$D  INTERRUPT FLAGS
C30E- 1770 IER .EQ DS1+$E  INTERRUPT ENABLE
1780 *
1790 *
1800 *      .OR $0280 START IT HERE
1810 *      .TF DOSCLOCK.BELL.OBJ
1820 *
1830 *      CLOCK ENTRY POINT
1840 *
1850 *
1860 *      SET UP IRQ VECTOR AND START THE CLOCK
1870 *
1880 *
1890 *
0280- 78 1900 CLOK SEI      DISABLE IRQ
0281- A9 B0 1910 LDA $ISR  ADDRESS OF INTERRUPT SERVICE ROUTINE
0283- 8D FE 03 1920 STA IRQV  SAVE IN IRQ
0284- A9 02 1930 LDA /ISR  LAST HALF OF ADDRESS
0288- 8D FF 03 1940 STA IRQV+1 SAVE IT
1950 *
1960 *
1970 *      SET UP THE 6522
1980 *
1990 *
028B- A9 C0 2000 LDA $C0  ENABLE T1 INTERRUPT
028D- 8D 0E C3 2010 STA IER  BY LOADING THIS LOCATION
0290- A9 E0 2020 LDA $E0  T1 FREE RUN MODE
0292- 8D 0B C3 2030 STA ACR  AND T2 COUNTS PB6
2040 *
2050 *
2060 *      YOU CAN PLAY WITH THE VALUE IN T1L AND T1H TO
2070 *      CORRECT TIME INACCURACIES.
2080 *
2090 *
0295- A9 20 2100 LDA $20  SET T1 TO F920
0297- 8D 04 C3 2110 STA T1L  WHICH IS 1/16TH OF
029A- A9 F9 2120 LDA $F9  A SECOND
029C- 8D 05 C3 2130 STA T1H  START T1
029F- A9 08 2140 LDA $08  T2 OVERFLOWS AFTER 1 SECOND IF
02A1- 8D 08 C3 2150 STA T2L  DOS TURNED OFF IRQ INTERRUPT
02A4- A9 00 2160 LDA $00  $800 IS ONE SECOND
02A6- 8D 09 C3 2170 STA T2H  T2 COUNTS T1
02A9- A9 F0 2180 LDA $F0  COUNT 16 INTERRUPTS
02AB- 8D 7F 04 2190 STA FRAC  PRELOAD THE LOCATION
02AE- 58 2200 CLI      ENABLE IRQ
02AF- 60 2210 RTS      RETURN
2220 *
2230 *
2240 *      INTERRUPT SERVICE ROUTINE
2250 *
2260 *
02B0- EE 7F 04 2270 ISR  INC FRAC  BUMP COUNTER
02B3- D0 70 2280 BNE UNDO  NOT A FULL SECOND
02B5- A9 F0 2290 LDA $F0  RESET INTERRUPT COUNTER
02B7- 8D 7F 04 2300 STA FRAC  SAVE IT HERE
02BA- AD 00 C3 2310 LDA PB    IF T1 HAS ALREADY TICKED
02BD- 10 03 2320 BPL TOUT  WE HAVE TO ADD
02BF- EE 7F 04 2330 INC FRAC  ONE TO THE COUNT
02C2- A9 20 2340 TOUT LDA $20  GET MASK
02C4- 2C 0D C3 2350 BIT IFR  T2 TIMED OUT??
02C7- D0 62 2360 BNE CORR  NO
02C9- A9 08 2370 LDA $08  RESET T2 COUNTER
02CB- 8D 08 C3 2380 STA T2L  WITH A $800
2390 *
2400 *
2410 *      INCREMENT THE SOFTWARE CLOCK
2420 *
2430 *
02CE- EE FF 04 2440 SECS INC SEC  BUMP SECONDS
02D1- AD FF 04 2450 LDA SEC  GET CURRENT SECONDS
02D4- C9 3C 2460 CMP $60  60 SECONDS??
02D6- 90 23 2470 BCC SHOW  NO
02D8- A9 00 2480 LDA $00  RESET SECONDS
02DA- 8D FF 04 2490 STA SEC  TO ZERO
02DD- EE 7F 05 2500 MINS INC MIN  BUMP MINUTES
02E0- AD 7F 05 2510 LDA MIN  GET CURRENT MINUTES
02E3- C9 3C 2520 CMP $60  60 MINUTES??
02E5- 90 14 2530 BCC SHOW  NO
02E7- A9 00 2540 LDA $00  RESET MINUTES
02E9- 8D 7F 05 2550 STA MIN  TO ZERO
02EC- EE FF 05 2560 HRS INC HOUR  BUMP HOURS
02EF- AD FF 05 2570 LDA HOUR  GET CURRENT HOUR
02F2- C9 18 2580 CMP $24  24 HOURS??
02F4- 90 05 2590 BCC SHOW  NO
02F6- A9 00 2600 LDA $00  RESET HOURS
02F8- 8D FF 05 2610 STA HOUR  TO ZERO
2620 *
2630 *
2640 *      DISPLAY THE TIME IF DESIRED

```

Listing 2 continued on page



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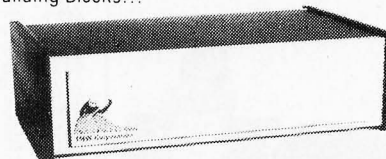
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### Listing 2 continued:

```

2650 *
2650 *
02FB- AD 7F 07 2670 SHOW LDA FLAG DISPLAY TIME??
02FE- F0 20 2680 REQ DONE NO
0300- BE 7F 06 2690 STX THPL SAVE X
0303- 8C FF 06 2700 STY THPH SAVE Y
0306- A2 00 2710 LDX #00 CLEAR X
0308- AD FF 05 2720 LDA HOUR GET THE CURRENT HOUR
030B- 20 94 03 2730 JSR DSPL PRINT IT
030E- AD 7F 05 2740 LDA MIN GET CURRENT MINUTE
0311- 20 7C 03 2750 JSR DCOL PRINT IT
0314- AD FF 04 2760 LDA SEC GET CURRENT SECONDS
0317- 20 7C 03 2770 JSR DCOL DISPLAY IT
031A- AE 7F 06 2780 LDX THPL RESTORE X
031D- AC FF 06 2790 LDY THPH RESTORE Y
2800 *
2810 *
2820 *
2830 *
2840 *
0320- A9 00 2850 DONE LDA #00 GET A ZERO
0322- 8D 09 C3 2860 STA T2H START T2
0325- AD 04 C3 2870 UNDO LDA T1L CLEAR INTERRUPT FLAG
0328- A5 45 2880 LDA ACC RESTORE ACCUM.
032A- 40 2890 RTI INTERRUPT RETURN
2900 *
2910 *
2920 *
2930 *
2940 *
032B- 38 2950 CORR SEC SAVE 2'S COMPLEMENT OF T2
032C- A9 00 2960 LDA #00 BY SUBTRACTING
032E- ED 08 C3 2970 SBC T2L FROM ZERO
0331- 8D 7F 06 2980 STA THPL SAVE PARTIAL RESULT
0334- A9 00 2990 LDA #00 ANOTHER ZERO
0336- ED 09 C3 3000 SBC T2H AND THE SUBTRACT
0339- 8D FF 06 3010 STA THPH SAVE IT
3020 *
3030 *
3040 *
3050 *
3060 *
DO THE CORRECTION
033C- AD 7F 06 3070 SETF LDA THPL SET FRACTION
033F- 29 07 3080 AND #07 TO CORRECT
0341- 0A 3090 ASL 1/16
0342- 6D 7F 04 3100 ADC FRAC OF A SEC
0345- 8D 7F 04 3110 STA FRAC SAVE IT BACK
0348- 29 0F 3120 AND #0F CORRECT T2
034A- 4A 3130 LSR TO THE PARTIAL
034B- 49 FF 3140 EOR #FF NUMBER OF
034D- 18 3150 CLC OF TICKS
034E- 69 09 3160 ADC #09 LEFT IN ITS INTERVAL
0350- 8D 08 C3 3170 STA T2L AND SAVE BACK
0353- 4E FF 06 3180 LSR THPH DIVIDE BY EIGHT
0356- 6E 7F 06 3190 ROR THPL TO GET NUMBER
0359- 4E FF 06 3200 LSR THPH OF FULL SECONDS
035C- 6E 7F 06 3210 ROR THPL TO ADD TO THE
035F- 4E FF 06 3220 LSR THPH TIME TO CORRECT
0362- 6E 7F 06 3230 ROR THPL FOR DOS BEING ON
0365- 18 3240 CLC SETUP THE CARRY
0366- AD FF 04 3250 LDA SEC ADD THE FULL
0369- 69 01 3260 ADC #01 SECONDS
036B- 6D 7F 06 3270 ADC THPL AND STORE IN
036E- 8D FF 04 3280 STA SEC SECONDS COUNTER
0371- 38 3290 SEC CHECK FOR GREATER
0372- E9 3C 3300 SBC #60 THAN 60 SECONDS
0374- 90 B5 3310 BCC SHOW TO SEE IF A MINUTE
0376- 8D FF 04 3320 STA SEC UPDATE IS
0379- 4C DD 02 3330 JMP MINS REQUIRED
3340 *
3350 *
3360 *
3370 *
3380 *
037C- A8 3390 DCOL TAY SAVE COUNT
037D- A9 BA 3400 LDA #BA GET A COLON
037F- 9D 20 04 3410 STA SCRNX SHOW IT
0382- E8 3420 INX BUMP COUNTER
0383- 98 3430 TYA RESTORE COUNT
0384- A0 FF 3440 DSPL LDY #FF DISPLAY TIME
0386- C8 3450 CNTY INY Y WILL COUNT BY 10
0387- 38 3460 SEC SET CARRY
0388- E9 0A 3470 SBC #10 MINUS 10
038A- B0 FA 3480 BCS CNTY GET RID OF TENS
038C- 69 CA 3490 ADC #10 RESTORE REMAINDER
038E- 48 3500 PHA AND SAVE
038F- 98 3510 TYA DISPLAY TENS DIGIT
0390- 69 B0 3520 ORA #B0 MAKE IT ASCII
0392- 9D 20 04 3530 STA SCRNX SHOW IT
0395- E8 3540 INX BUMP X
0396- 68 3550 PLA GET ONES DIGIT
0397- 69 B0 3560 ORA #B0 MAKE IT ASCII
0399- 9D 20 04 3570 STA SCRNX SHOW IT
039C- E8 3580 INX BUMP THE COUNT
039D- 60 3590 RTS RETURN
3600 .EN

```

### SYMBOL TABLE

0045- ACC	0300- IFR	04FF- THPH
0308- ACR	03FE- IRQV	047F- THPL
0280- CLK	02B0- ISR	02C2- TOUT
0386- CNTY	057F- MIN	0325- UNDO
032B- CORR	02BD- MINS	
037C- DCOL	038C- PB	
0320- DORE	042C- SCRNX	
0300- DS1	04FF- SEC	
0384- DSPL	02DF- SECS	
027F- FLAG	034C- SETF	
047F- FRAC	02B8- SHOW	
047F- FREE	0305- T1H	
05F- HOUR	0304- T1L	
02EC- HRS	0309- T2H	
030E- IER	0308- T2L	



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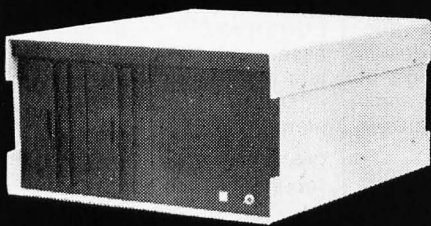


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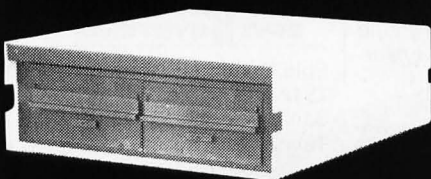
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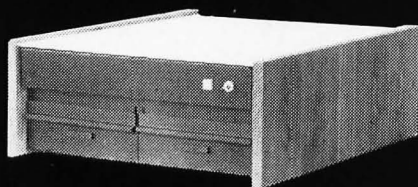
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Text continued from page 418

clocks data into the printer's internal buffer. Again, the MX-80 requires a negative-going pulse for the data strobe; use control pin CA2 for this function.

The 6522 allows you to choose a negative- or positive-going pulse for either of two signals; inform the 6522 of the desired polarity by loading the Peripheral Control Register (PCR). With the MX-80, hexadecimal 0A is the proper code. This bit pattern is determined by consulting the coded values on the data sheet. We enable the printer by sending it a Control Q (hexadecimal 11) and then a Control X to clear the internal buffer.

The actual output routine is quite simple. First, check the horizontal character position and compare it with the current character position in the output line. If they differ, output spaces until reaching the proper character position. To print characters, check bit 2 in the Interrupt Flag Register (IFR) to see if the printer has sent its data-ready flag. This bit will

be set if the 6522 has detected a negative edge on control pin 1 (CA1), which is the ready line.

If the printer is busy or has yet to send the ready pulse, keep testing the bit until the printer is ready. When the printer is ready to receive data, store the character to be printed in the output register for port A. As you place the character in the output register, it's clocked into the printer's internal register because pin CA2 goes low and acts as the data strobe. The printer becomes busy while accepting the character. Once it's processed, the ready pulse is given and the printer will accept another character.

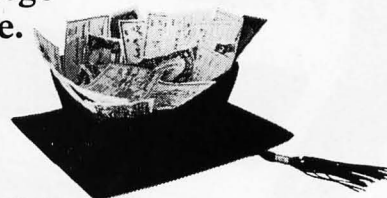
**Time-of-Day Clock.** Listing 2's routine is a time-of-day clock that continuously displays the time on the screen. The routine uses interrupts so that the clock runs while you develop and run BASIC programs. The routine is compatible with DOS 3.3; DOS disables the IRQ interrupt while it does I/O and then re-enables the interrupt when finished. (I haven't tried

**Listing 3:** This BASIC routine will load and initialize the clock. It will also protect the time display.

```

:PR#0
>LIST
10 REM
20 REM
30 REM ROUTINE TO LOAD AND START THE DOSCLOCK
40 REM
50 REM
60 PRINT "LOAD DOSCLOCK, BELL.OBJ"
70 POKE 34,0: CALL -936
80 PRINT "THE CURRENT TIME IS -- >": POKE 34,2
90 UNTIL 10
100 INPUT "ENTER HH,MM,SS ",H,M,S
110 POKE 1535,H: REM HOURS
120 POKE 1407,M: REM MINUTES
130 POKE 1279,S: REM SECONDS
140 CALL 640: REM START THE CLOCK
150 POKE 1919,1: REM DISPLAY TIME
160 END
    
```

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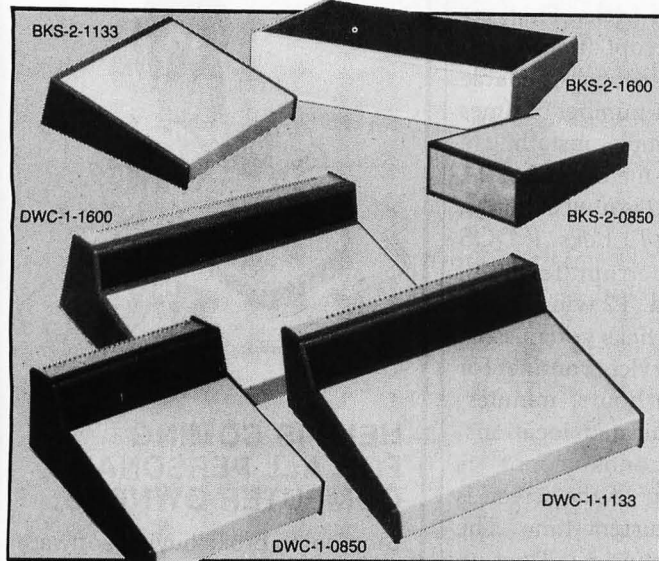
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the routine with earlier DOS versions. If you plan to, back up your disks in the event of failure.)

My method of implementing the clock involves both timers on one 6522 and a couple of tricks. First, set up timer T1 to interrupt (tick) every  $\frac{1}{16}$  second. Simultaneously, enable timer T2 to count the number of times that T1 ticks by simply installing a jumper wire to feed the output of T1 to the input of T2. T2 is now counting the number of times T1 ticks. If DOS turns off the IRQ interrupt (for I/O), when it is re-enabled T2 will contain the number of clock ticks you missed.

The interrupt service routine for the clock keeps the hours, minutes, and seconds in dedicated locations. Whenever the seconds count is changed, the top line of the screen is updated with the current time. The BASIC routine in listing 3 will set up the current time of day and protect the top line. From then on, time will be displayed continuously. The clock routine can determine execution times of routines or schedule other events at certain times during the day. Because no two Apples have identical time bases, some correction factors may have to be used. The listing indicates where to apply those factors.

## Conclusions

- The Apple parallel board may be used for all interfacing projects where parallel I/O is needed or where timing or counting is required.
- The board contains two 6522 support chips for input or output, timing or counting, and serial-to-parallel/parallel-to-serial operations.
- The board is available fully assembled, as a kit, or alone. The kit is easy to build, but you must be able to read a circuit diagram.
- Documentation is sparse, though all required information for use of the 6522 is included. The manufacturer does *not* hold your hand, relying instead on the user community to publish software that uses the board.
- The Apple parallel board is a good, inexpensive way to enhance the Apple with the power of the 6522 Versatile Interface Adapter. ■

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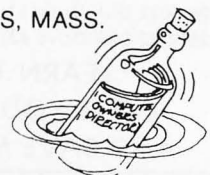
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*Aircraft Electricity and Electronics*, 3rd edition, Ralph D. Bent and James L. McKinley. New York: Gregg/McGraw-Hill, 1981; 359 pages, 27.5 by 20.5 cm, softcover, ISBN 0-07-004793-6, \$19.95.

*The Complete Problem Solver*, John R. Hayes. Philadelphia, PA: The Franklin Institute Press, 1981; 255 pages, 25 by 17.5 cm, hardcover, ISBN 0-89168-028-4, \$19.50.

*The Computers Are Coming*, Irv Brechner. Livingston, NJ: Irv Brechner (POB 453), 1981; 92 pages, 22.5 by 14.5 cm, softcover, ISBN none, \$4.95.

*Digital Circuits and Microprocessors*, Herbert Taub. New York: McGraw-Hill,

1982; 541 pages, 23.5 by 16.5 cm, hardcover, ISBN 0-07-062945-5, \$28.95.

*The Electronic Cottage*, Joseph Deken. New York: William Morrow and Company, 1982; 344 pages, 23.5 by 16 cm, hardcover, ISBN 0-688-00664-7, \$14.95.

*50 More Programs in BASIC for the Home, School & Office*, 2nd edition, Jim Cole. Woodsboro, MD: Arcsoft Publishers, 1981; 96 pages, 21 by 13.5 cm, softcover, ISBN 0-86668-502-2, \$9.95.

*The Handbook of Artificial Intelligence, Volume 1*, Avron Barr and Edward A. Feigenbaum, eds. Los Altos, CA: William Kaufmann, 1981; 409 pages, 23.5 by 15.5 cm, hardcover, ISBN 0-86576-

005-5, \$30.

*Handbook of Semiconductor and Bubble Memories*, Walter A. Triebel and Alfred E. Chu. Englewood Cliffs, NJ: Prentice-Hall, 1982; 401 pages, 23 by 18.5 cm, hardcover, ISBN 0-13-381251-0, \$24.95.

*How to Break into the Computer Field*, L. Peter Carron. Easton, PA: L. P. Carron Publishers (205 Ridge-wood Rd.), 1981; 138 pages, 22.5 by 14.5 cm, softcover, ISBN 0-9607242-0-6, \$7.95.

*Introduction to Microprocessors*, Charles M. Gilmore. New York: Gregg/McGraw-Hill, 1981; 310 pages, 27.5 by 21 cm, softcover, ISBN 0-07-023301-2, \$14.96.

*Learning Digital Electronics Through Experiments*, Ed-

ward J. Pasahow. New York: Gregg/McGraw-Hill, 1982; 215 pages, 22 by 14.5 cm, softcover, ISBN 0-07-048622-7, \$8.95.

*The Making of the Micro, A History of the Computer*, Christopher Evans. New York: Van Nostrand Reinhold, 1981; 118 pages, 26 by 18.5 cm, hardcover, ISBN 0-442-22240-8, \$14.95.

*Mathematics into Type*, revised edition, Ellen Swanson. Providence, RI: American Mathematical Society (POB 6248), 1979; 90 pages, 24.5 by 17.5 cm, softcover, ISBN 0-8218-0053-1, \$12.40.

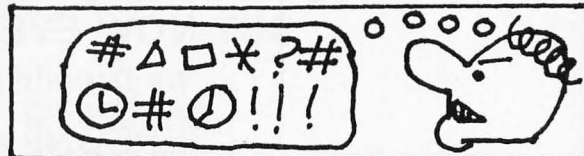
*Murder in the Mansion, And Other Computer Adventures in Pocket-BASIC for the TRS-80*, 2nd edition, Jim Cole. Woodsboro, MD:

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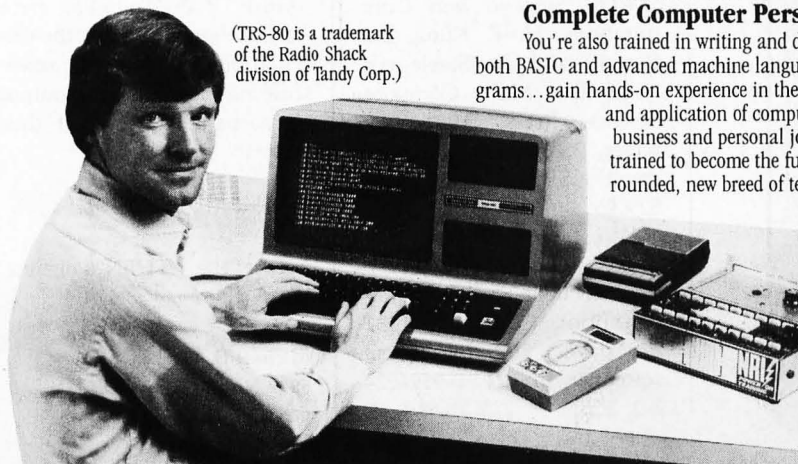
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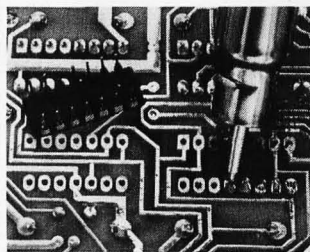
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	TI Insight 10 Terminal	695	67	37	25
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	TI787 Portable KSR, 120 CPS	2,845	273	152	102
	TI810 RO Printer	1,695	162	90	61
	TI820 KSR Printer	2,195	211	117	80
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	ADM5 CRT Terminal	645	62	36	24
	ADM32 CRT Terminal	1,165	112	65	42
	ADM42 CRT Terminal	1,995	190	106	72
DATAMEDIA	DT80/1 CRT Terminal	1,695	162	90	61
	DT80/3 CRT Terminal	1,295	125	70	48
	DT80/5L APL 15" CRT	2,295	220	122	83
TELEVIDEO	920 CRT Terminal	895	86	48	32
	950 CRT Terminal	1,075	103	57	39
NEC SPINWRITER	Letter Quality, 7715 RO	2,895	278	154	104
	Letter Quality, 7725 KSR	3,295	316	175	119
GENERAL ELECTRIC	2030 KSR Printer 30 CPS	1,195	115	67	43
	2120 KSR Printer 120 CPS	2,195	211	117	80
HAZELTINE	Executive 80/20	1,345	127	75	49
	Executive 80/30	1,695	162	90	61
EPSON	MX-80 F/T Printer	745	71	42	27
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## Books Received

Arcsoft Publishers, 1981; 96 pages, 21 by 13 cm, softcover, ISBN 0-86668-501-4, \$6.95.

*Nonlinear System Theory, The Volterra/Wiener Approach*, Wilson J. Rugh. Baltimore, MD: The Johns Hopkins University Press, 1981; 325 pages, 23 by 18.5 cm, hardcover, ISBN 0-8018-2549-0, \$32.50.

*Optimization: A Simplified Approach*, William Conley. Princeton, NJ: Petrocelli Books, 1981; 248 pages, 23.5 by 15.5 cm, hardcover, ISBN 0-89433-121-3, \$20.

*Programs for Beginners on the TRS-80*, Fred Blechman. Rochelle Park, NJ: Hayden Book Company, 1981; 150 pages, 17.5 by 24.5 cm, softcover, ISBN 0-8104-5182-4, \$8.95.

*Real Time Programming—Neglected Topics*, Caxton C. Foster. Reading, MA: Addison-Wesley, 1981; 190 pages, 23 by 15.5 cm, softcover, ISBN 0-201-01937-X, \$9.95.

*RPG & RPG II Primer, A Modern Approach*, H. Mullish and R. Kestenbaum. New York: Holt, Rinehart and Winston, 1982; 189 pages, 27.5 by 20.5 cm, softcover, ISBN 0-03-056918-4, \$17.95.

*Standard BASIC Programming for Business and Management Applications*, James S. Quasney and John Maniotes. San Francisco, CA: Boyd & Fraser Publishing Company, 1980; 408 pages, 17.5 by 25 cm, softcover, ISBN 0-87835-081-0, \$13.95.

*VLSI Systems and Computations*, H. T. Kung, Bob Sproull, and Guy Steele, eds. Rockville, MD: Computer Science Press, 1981; 415 pages, 23.5 by 16 cm, hardcover, ISBN 0-914894-35-8, \$29.95.

*Webster's Microcomputer Buyer's Guide*, Tony Webster. Rochelle Park, NJ: Hayden Book Company, 1981; 326 pages, 26.5 by 21 cm, softcover, ISBN 0-9594624-2-2, \$25.

*Without Me You're Nothing: The Essential Guide to Home Computers*, Frank Herbert and Max Barnard. New York: Pocket Books, 1981; 304 pages, 20.5 by 13 cm, softcover, ISBN 0-671-43964-2, \$5.95. ■

This is a list of books received at BYTE Publications during this past month. Although the list is not meant to be exhaustive, its purpose is to acquaint BYTE readers with recently published titles in computer science and related fields. We regret that we cannot review or comment on all the books we receive; instead, this list is meant to be a monthly acknowledgment of these books and the publishers who sent them.

## BYTE's Bugs

### Inflated Bug

Joe Hadleman's inflation calculator program in the July 1981 BYTE has a bug in line 440, page 302. (See "Computing Inflation with the Consumer Price Index," page 300.) If:

$STR\$(P2-INT(P2))$

is less than 0.01 (in other words, if the rounding error is less than a penny), the calculation is handled in scientific notation and the output is garbage. To correct this, insert:

$OR\ IF\ (P2-INT(P2)) < .01$

before the "THEN" of line 430.

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Written by the founder of a successful systems house, this fact-filled 220-page manual covers virtually all aspects of starting and operating a small systems company. It is abundant with useful, real-life samples: contracts, proposals, agreements and a complete business plan are included in full, and may be used immediately by the reader. Proven, field-tested solutions to the many problems facing small turnkey vendors are presented.

## HOW TO BECOME A SUCCESSFUL COMPUTER CONSULTANT

by Leslie Nelson, 4th revised edition, December 1981

\$28.

Independent consultants are becoming a vitally important factor in the micro-computer field, filling the gap between the computer vendors and commercial/industrial users. The rewards of the consultant can be high: freedom, more satisfying work and doubled or tripled income. This manual provides comprehensive background information and step-by-step directions for those interested to explore this lucrative field.

## FREE-LANCE SOFTWARE MARKETING

by B.J. Korites, 3rd edition, June 1980

\$30.

Writing and selling computer programs as an independent is a business where • you can get started quickly, with little capital investment • you can do it full time or part time • the potential profits are almost limitless. This best-seller by Dr. Korites explains how to do it.

## SOFTWARE VENDOR DIRECTORY

5th edition, October 1981

\$59.95

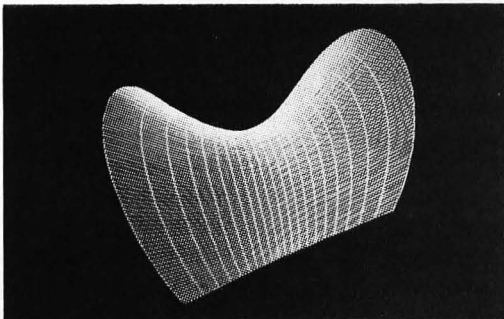
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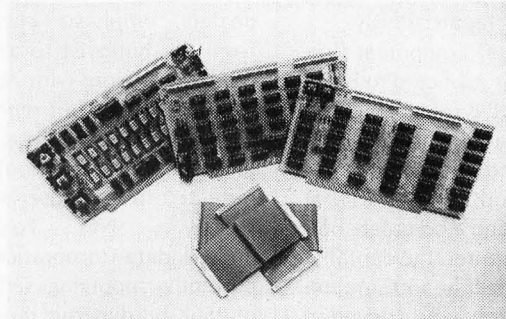
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# BYTELINES

## News and Speculation about Personal Computing

Conducted by Sol Libes

**R**andom Rumors: IBM is rumored to be increasing production of its personal computer system, with 175,000 units expected to be sold before Christmas 1982. IBM will probably soon announce a graphics package and X.25 communications options for the personal computer. . . . Epson America is expected to introduce several video terminals, including one with a flat screen. The rumor is that they will be shown at the NCC (National Computer Conference) in June; look for Sinclair, Sony, and Hitachi to introduce similar products at NCC. Also due at NCC are 80- and 160-megabyte 8-inch Winchester hard-disk drives from Micropolis and 16- and 30-megabyte 5¼-inch Winchesters from Control Data Corp. . . . Reportedly, a 15-inch flat-screen monitor is due from Japan shortly. . . . DEC (Digital Equipment Corporation) is expected to introduce a PDP-8 replacement, a 16-bit version of its recently introduced personal-computer board for the VT-100 terminal, and a complete personal computer. Incidentally, DEC is budgeting \$500 million for research and development, with half going to software development and its 2000-member software development team. . . . Hearsay has it that Centronics is working on a ribbonless dot-matrix printer. . . . NEC (Nippon Electric Company) is supposedly about to introduce two new systems in the U.S., both of which are already on the market in Japan: the PC6000, a consumer-oriented machine, and the PC8800, an 8086-based machine for the

business market. . . . Commodore is said to be working on a new version of the VIC computer for introduction early next year. The unit should have 256K bytes of memory and 80-column black and white or color video display. . . . Look for the upgrade of the Osborne-I to be introduced later this year. It's rumored to have an 80-character-wide display (versus the current 52-column unit), double-density floppy-disk drives, a built-in modem, and a communications package. A significant jump in price will probably accompany it. . . . Toshiba is also expected to introduce into the U.S. a product it's already selling in Japan—a Z80-based system that runs CP/M, T-Basic, and UCSD Pascal.

**R**andom Bits: At the recent Comdex show held for dealers, emphasis changed from the hobbyist to a business orientation, with Apples and TRS-80s all but replaced by integrated business systems. This change should be reflected in computer stores shortly. . . . NEC, Toshiba, and Okidata Corporation are currently supplying samples of 256K-bit dynamic memory devices and expect to start volume delivery in June. These ICs should begin showing up in equipment by the middle of 1983. . . . S D Systems will introduce yet another local-network system called MARS/NET. . . . Mitsubishi is supplying samples of its 5¼-inch Winchester disk drives and half-wide floppy-disk drives; Toshiba is also considering sale of its 5¼-inch Winchester in the U.S. Shugart's half-height 5¼-inch

SA210 floppy-disk drive will make its first appearance in Xerox's new Sabre line of electronic typewriters. . . . WD (Western Digital) is expected to shortly introduce a single-chip Winchester controller that replaces 25 TTL (transistor-transistor logic) parts. Also due from WD is a new floppy-disk drive controller IC that incorporates the data separator, comparator, and write-precompensation circuits missing from current controllers. . . . IBM recently opened its tenth computer store; more are in the works. . . . Seagate has introduced a 6-megabyte, 5¼-inch Winchester with removable media. . . . Emulog of Freemont, California, has introduced a full-feature video terminal with a \$465 list price. . . . HP (Hewlett-Packard) has separated its personal-computer operation from the calculator division and created a Personal Computation Group. HP has also increased dealer discounts on models 80, 85, and 125 systems by as much as 25 percent over previous discounts. . . . Radio Shack has beaten Apple into the 16-bit market with the introduction of its new Model 16, 68000-based microcomputer. For more details on this machine and other new products, see page 40. Radio Shack has also established an online videotex-information data-base system for subscribers in the Forth Worth area.

### Unix Royalty Fees Cut:

Western Electric recently introduced its Unix System III update which combines Ver-

sion 7 Unix and the PWB (Programmer's Workbench) into a single system. Some enhancements have also been added. They raised the source code license fee to \$43,000 but lowered the distribution deposit from \$50,000 to \$25,000 against royalties. The royalty fees have been reduced to \$100 for a single user and \$250 for systems for 2 to 16 users. (Previously, a license cost \$1500 plus \$250 per user.)

Royalties prepaid under the old rates will not be refunded. Licensees will, in effect, start with a clean slate. Hence, Microsoft will lose the \$200,000 it had prepaid to obtain a discount advantage, an advantage it no longer has.

The reduction in royalty fees removes what has been a significant deterrent for people wishing to use Unix, namely that it was very expensive. This should increase competition among Unix and its look-alikes. More important, it puts Unix in a much better position to compete with other single- and multi-user operating systems such as CP/M-86 and MP/M-86. Microsoft's president, Bill Gates, indicated that despite his unhappiness about the lost royalty payment, the royalty change would help his company sell copies of Xenix, its version of Unix.

**A**da Update: Ada is finally becoming available as a working language. Telesoft Incorporated of San Diego, California, released its Ada package for 68000 systems last August, and RR Software of Madison, Wisconsin, in November released Janus, a



version for Z80 computers running CP/M. Both compile subsets of the Ada language. The Telesoft Ada compiler retails at \$2400, while Janus sells for \$250.

The DOD (Department of Defense) holds the trademark on the name "Ada" and stipulates that commercial companies can use the name only if they have or are developing a full-language compiler. To acquire legal access to the name "Ada," a company must submit its product to a DOD Ada-validation office for approval. Validation will ensure that programs written with the compiler will be fully portable between computers. Portability of that type doesn't exist for system-oriented languages such as Pascal, FORTH, and C.

Western Digital, based in Irvine, California, has also demonstrated its microAda and expects to be the first company to submit a complete Ada compiler to the DOD for validation. WD plans to submit it within the next 3 to 4 months. The WD Ada will run only on WD's new PAL 16-bit computer; a WD microAda license will cost \$2000.

SuperSoft Associates of Champaign, Illinois, has demonstrated its Ada compiler for Z80 systems, also expected to be ready for submission to the DOD for validation sometime this year. SuperSoft intends to release Intel 8086/8088, Motorola 68000, and Zilog Z8000 versions, with the Z80 version to sell for under \$300.

Telesoft is developing versions of its Ada compiler to run on the 8086, DEC VAX, and IBM 370 machines. Intel has developed an Ada compiler for its iAPX432 32-bit microcomputer currently running at beta test sites. Intel is preparing to submit the compiler for DOD validation.

## **A**nd Ethernet's Fate?

A report issued by Strategic Incorporated, a market-research firm in San Jose, California, predicts Xerox Corporation's Ethernet local-area network will be a total failure within two years. According to Strategic's president, Michael Killen, "Xerox is headed for the worst failure in the company's history." He believes that Xerox lacks technological and price advantages, sales force, and customers interested in buying large systems. Further, he contends that Ethernet's baseband approach to local networking will prove inferior over the long haul to the broadband approach taken by Xerox's competitors. He points out that broadband systems are better suited to carry video, heavy voice and data transmissions, among other applications.

In response to the report, Xerox issued the following statement: "Based on the level of customer satisfaction with our existing network installations, the backlog of orders for network products and service, and the interest in Ethernet on the part of major accounts, we are confident that Xerox will be a leading vendor in office automation."

## **B**ell Set to Move Into Computer-Related Markets

AT&T (American Telephone and Telegraph) is undergoing a major management reorganization to comply with the FCC-required separation of regulated and deregulated activities. As a result, look for the Bell System to become an unbridled competitor in computer-related markets. It will probably begin marketing terminals and business computers soon, competing directly

with companies such as IBM, Wang, Xerox, and DEC in the intelligent-terminal and workstation markets and with Tymnet and Telenet in the communications-processing field. It is unlikely that Bell will compete directly with IBM in the mainframe business.

The Bell System itself presents a large, captive market for computer products. Actually, the Bell System is IBM's biggest customer outside of the U.S. government. Bell is expected to sell business and personal computers through its many Phone Center stores.

AT&T has also agreed to provide CBS (Columbia Broadcasting System) with home-computer terminals, data-entry equipment, and transmission facilities for a joint teletext experiment scheduled to begin this fall in New Jersey.

## **A** National Amateur Computer Society

The Japan Microcomputer Club is well organized, registers close to 4000 members, and has chapters in every major city in Japan. Hobbyists in England also work together through one central organization, providing an excellent base for the computer industry.

Computer hobbyists have long been the backbone of technological growth, but in the U.S., the hobbyist community is fragmented into several hundred independent clubs. A handful of clubs have over 1000 members, but most include fewer than 100. While some attempts have been made to found a national organization, none has succeeded.

Personal computing as a hobby is a breeding ground for computer professionals of tomorrow. Therefore, it's vital that we organize a national

amateur computer society while we are still the world's technological leader in computing.

**C**P/M Goes Into Firmware: Digital Research has signed an agreement with Intel which will allow the latter to sell ROMs encoded with the CP/M-86 operating system. The ROM will also contain timers and some logic; it should be available by mid-year. The ROM is intended for use in a CP/net system where systems containing CP/M in firmware don't have any disk but must communicate with a CP/M or MP/M server.

Intel will also sell CP/M-86 and MP/M-86 on disk for its single-board and 86/330 system. Intel has contracted with Microsoft for its MS-DOS (used on the IBM personal computer). Intel will sell its own RMX-86 DOS and plans to acquire Unix from Western Electric. Hence, Intel users and systems houses will be able to select among a wide variety of operating systems. Intel also expects to market applications software.

## **D**igital Research Buys MT Microsystems

Digital Research has acquired its second software company in less than three months by purchasing MT MicroSystems Incorporated of San Diego, California, supplier of Pascal/MT. Previously, Digital Research had purchased Compiler Systems Incorporated, supplier of CBasic.

## **E**xxon Buys Out Zilog

Over the years, Exxon Corporation has moved from a minor investor in Zilog Incorporated, supplier of the Z80, to a major investor, owning



90 percent of the stock. Zilog has bought the remaining 10 percent and will become a wholly owned Exxon subsidiary. One result is that Exxon will no longer be required to break out Zilog's quarterly earnings for shareholders. Zilog, incidentally, has yet to report a profit. In fact, the Exxon Enterprises operation, which includes all of Exxon's electronics subsidiaries, incurred a loss of \$51 million in the first nine months of 1981.

## Microprocessor

**Trends:** Did you know that there are currently 51 different general-purpose microprocessors in production, that 17 are 4-bit devices, 14 are 8-bit devices, 6 are 16-bit devices, 4 are 32-bit devices with 16-bit I/O, 4 are bipolar, and 5 are microframe or special (e.g., Intel iAPX432)? Further, did you know that seven more have been announced but are not yet in production, and that 42 companies currently manufacture microprocessors?

The microprocessor recently celebrated its tenth birthday. Credit for creating the microprocessor goes to Intel. (See this month's Editorial on page 6.) Ten years ago, the

companies that designed micros were mostly small, freewheeling organizations employing a great deal of ingenuity. Today, it is a totally different ballgame. Most of those early pioneers were either swallowed up by large companies (e.g., Zilog and MOS Technology) or are now very large companies (e.g., Intel, AMD, and National Semiconductor). Furthermore, leadership in design and production appears to be passing to the Japanese.

The microprocessor scene has changed a lot over these ten years. The question now is: what are the current trends and directions of the new micros? First of all, suppliers are making micros easier to program. National and Zilog already have micros with software-in-silicon. They each provide single-chip computers that execute BASIC statements directly in an interpretive mode. Furthermore, Intel is developing one micro with the capability to execute MP/M and another with a sophisticated on-board operating system. Also, there are rumors of a one-chip FORTH computer. There's no doubt that both National and Zilog have been successful with BASIC-processing ICs.

Second, microcomputer ICs are getting more sophisticated, having floating-point capability, multiply/divide functions, enhanced interrupt handling, and the like.

The most glamorous changes will occur in the 16/32 bit micros. All of these devices are getting coprocessors to extend their capabilities into the minicomputer field. Incidentally, Zilog has disclosed that it's working on a 32-bit micro. If the 8-bit unit is a Z80, the 8/16-bit device is a Z800, and the 16-bit micro is the Z8000, what will its 32-bitter be called? You guessed it! The Z80000! Maybe Zilog would be better off calling it the Z8 × 10<sup>4</sup>.

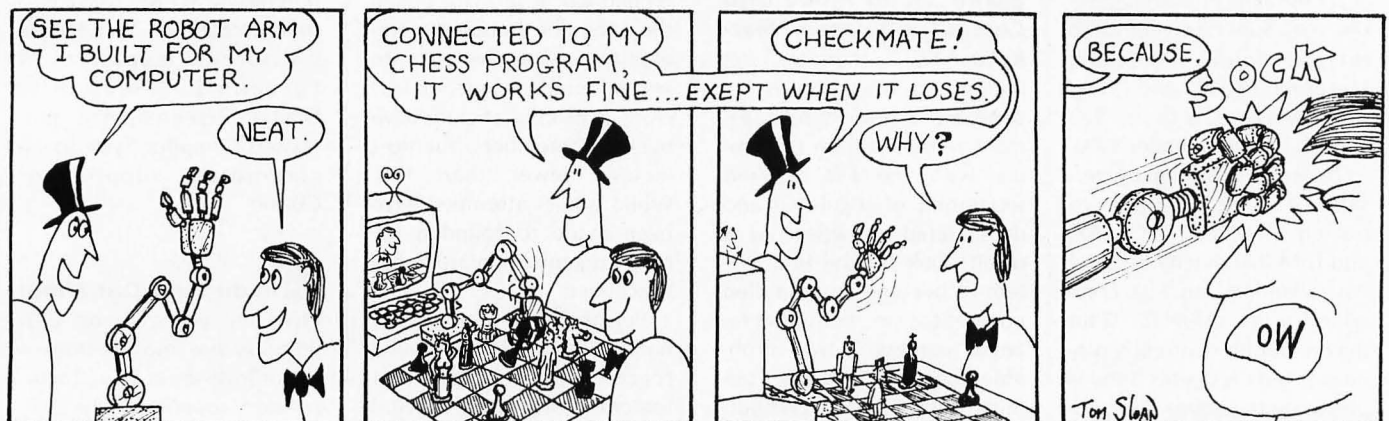
## Memory Trends... or, What Is Turbo and Parity?

I occasionally look back with fondness to my first micro. It had 256 bytes of memory and used an Intel 8008. That was only 8 years ago. The next year, I graduated to an Altair 8800 that had an 8080, six printed-circuit cards containing 4K bytes of RAM, an I/O channel, and a huge power supply. How times have changed!

The most significant change

has been in memory. Today the 16K-bit, single-voltage RAMs dominate the marketplace, providing cost savings (mostly by shrinking power-supply requirements), yielding faster operation, and making the 64K-byte computer memory nearly standard. The 64K-bit RAM ICs are just starting to appear, and we find that computer memory sizes of 128K bytes and 256K bytes are becoming more common and will probably become the standard microcomputer memory size by the end of 1983. The 256K-byte RAM chips are now going into production. I expect that by 1985 1 megabyte will probably be the typical microcomputer memory size. Also, as the volumetric memory space decreases, the associated access time decreases, resulting in increased system performance.

Some of the most interesting changes in memory design are improving memory reliability and speed. Memory manufacturers are beginning to introduce multifunction memory systems that perform parity or error-checking and correction functions previously handled by a computer's processor, if they were done at all. In fact, National





Semiconductor has introduced an IC (the DP8400) that performs all the memory error checking and correcting so that the processor is not bothered with this task. Error checking and correction is particularly important with dynamic RAM since these devices are prone to soft (transient) errors due to noise and radio-frequency interference, alpha particles, cosmic rays, and voltage fluctuations.

Manufacturers are also introducing on-board batteries to protect RAM during power failure. With the use of CMOS RAM, an on-board battery can protect data for over a hundred hours, and lithium-iodine batteries have been shown to be able to provide as much as one year of data retention.

The demand for faster computer access to disk drives has generated new cache techniques to reduce seek time and rotational latency delays that account for about 60 percent of throughput bottlenecks. This technique is called the "turbo disk file cache" or "turbo" for short. The turbo eliminates disk seeks to frequently used data by transferring such data to a cache memory (typically 128K bytes) and accessing the data from the cache instead of the disk. The data in the cache is kept current using an algorithm such that the block of data that has gone unaccessed the longest is replaced by the next nearest-in-use block of data. The turbo algorithm considers past use and the probability for future use. Software 2000

Incorporated of Arroyo Grande, California, for example, sells TurboDOS, which it claims runs CP/M software three to five times faster. The company has adapted its software to run on most of the popular S-100 systems, the Xerox 820, TRS-80 Model II, and others.

**Quote of the Month:**  
"By the end of the century, analysts predict, computers and information processing will be the world's biggest business after petroleum."  
*Wall Street Journal*,  
November 10, 1981.

**APOLOGY DUE:** I regret that in my November 1981 column I erroneously re-

ported that Canon was marketing the CX-1 computer via distributors responsible for software support. Canon has informed me that it markets the CX-1 directly to dealers and provides software support.

**MAIL:** I receive a large number of letters each month as a result of this column. If you write to me and wish a response, please include a self-addressed, stamped envelope.

**Sol Libes**  
**POB 1192**  
**Mountainside, NJ 07092**

TANTALUM CAPACITORS		LINEAR CIRCUITS		CRYSTALS	
47UF 35V 5/11.00	10UF 35V - \$ .40	LM201 - .75	LM311 - .50	2.000	3.000 5.000 8.000
82UF 35V 5/11.00	22UF 10V - \$ .30	LM318 - 1.00	LM331 749 - .30	18.432	3.579 6.000 10.000
1UF 35V 5/11.00	15UF 16V 3/11.00	741CV - .25	LM338 - .50	20.000	5.000 6.144 18.000
2.2UF 20V 5/11.00	30UF 6V 5/11.00	741C - .35	LM358 - .50	\$4.25 ea.	\$3.50 ea.
3.3UF 20V 4/11.00	47UF 20V \$ .85	LM351 - 1.75	741CH - .40		
4.7UF 35V 4/11.00	100UF 10V \$1.00	LM380 - .95	LM1888 - 1.75		
6.8UF 35V 3/11.00	220UF 6V \$ .75	747 - .50	LM1889 - 1.95		
	200UF 20V \$1.75	1456 - .80	CA758 - 1.75		
		4136 - .85	CA3018 - 1.95		
		3900 - .40	LM383 - 2.50		
		LM307 - .30	CA3078 - 1.50		
		LM308 - .75	CA3080 - .95		
		LM324 - .65	CA3086 - .95		
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# Clubs and Newsletters

## Apple Group In Little Rock

The Little Rock Apple Addicts publish a newsletter and hold meetings and program swaps. Guest speakers have shown members how to diagnose ailing Apples and have demonstrated programs and peripherals. Contact Little Rock Apple Addicts, POB 55215, Little Rock, AR 72205.

## Free Newsletter

*The Software Newsletter* is a free bimonthly publication of the Software Store in Los Angeles, California. It features news about personal and business CP/M software. Also included are reviews of microcomputer books, magazines, and games. Contact the Software Store, 11768 West Pico

Blvd., West Los Angeles, CA 90064, (213) 473-1136.

## Llano Estacado Computer Club

Llano Estacado Computer Club would like to exchange ideas with other computer clubs. Members are interested in all microcomputers. Write to John L. Peters, Llano Estacado Computer Club, 1509 Fairway Terrace, Clovis, NM 88101.

## Computer Association In Central Texas

The Central Texas Computer Association (CTCA) meets on the fourth Monday of the month at the Farm & Home Savings Building in

Austin, Texas. Club meetings include short demonstrations or informal talks on a variety of subjects relating to personal computers. A monthly journal, *PRINT-OUT*, has information on hardware and software, new equipment critiques, and a classified ad section free to members. The CTCA is active in community service, with a number of projects underway for the deaf. Membership dues are \$15. Contact CTCA, POB 17303, Austin, TX 78760.

## HUGs In Pittsburgh

The Pittsburgh Heath Users Group (HUG) meets the third Tuesday of every month at the Heathkit store (3482 William Penn Hwy.) from 7 to 9 p.m. For more information, call (412) 824-3564.

## Computer Dealers Society

The American Society of Computer Dealers (ASCD) is a new group devoted to promoting sound business practices in the used-computer industry. ASCD intends to cooperate fully with the Computer Dealers and Lessors Association in promoting ethical conduct standards. A code of ethics for ASCD members has been adopted. Meetings will be held twice a year, in February and July. For further details, contact ASCD, 3500 Southland Center, Dallas, TX 75201, or call Jerry Roberts at (313) 689-6200.

## Magazine for War Gamers

*The War Machine* is a bimonthly magazine dedicated to fans of computer war games. It features news,

reviews of complex games for all microcomputers, and advice for independent software writers. The latest issue can be obtained for \$3 from Emjay, 17 Langbank Ave., Rise Park, Nottingham NG5 5BU, England.

## Two New Groups In Munich

Two new microcomputer groups have been organized in Munich, West Germany. The European Branch of the Pascal Z Users Group has been formed in association with the American Pascal Z Users Group. And the second, the Ithaca Intersystems/S-100 Users Group plans to coordinate Ithaca users' efforts in Europe and to form a program exchange. Both groups can be contacted by writing George Brooke, Sebastian Bauerstrasse 20c, 8000 Munich 83, West Germany.

## Dental Computer News

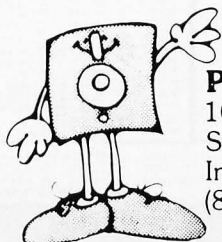
The *Dental Computer Newsletter* is a publication serving an international group of dentists, physicians, and office-management personnel who share a common interest in office computers. Members also have access to a software exchange and a computer bulletin board. Dues are \$15 domestic, \$23 overseas. Contact *Dental Computer Newsletter*, c/o E. J. Neiburger, 1000 North Ave., Waukegan, IL 60085. ■

## Maxell Floppy Disks

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(805) 543-1037.



# Software Received

## Apple

**Adventure in Time**, an adventure game for the Apple II. Floppy disk, \$29.95. Phoenix Software Inc., 64 Lake Zurich Dr., Lake Zurich, IL 60047.

**Birth of the Phoenix**, a tutorial adventure for the Apple II. Floppy disk, \$14.95. Phoenix Software Inc. (see address above).

**Circuit Design System**, a digital electronics design and simulation package for the Apple II. Floppy disk, \$149. Smart Software Co., POB 1292, Orem, UT 84057.

**Comma Usage/Semicolon and Colon Usage**, a punctuation usage tutorial for the Apple II. Cassette, \$20; floppy disk, \$25. LARA Software, 980 Hunting Valley Pl., Decatur, GA 30033.

**Context Connector**, a Visicalc utility program for the Apple II. Floppy disk, \$180. Context Management Systems Inc., 23864 Hawthorne Blvd., Torrance, CA 90505.

**Datalink**, a telecommunications package in Pascal for the Apple II. Floppy disk, \$100. Link Systems, 1655 26th St., Santa Monica, CA 90404.

**Linkdisk**, a disk-utility package in Pascal for the Apple II. Floppy disk, \$70. Link Systems (see address above).

**Linkindex**, a rapid key data-file retrieval system in Pascal for the Apple II. Floppy disk, \$150. Link Systems (see address above).

**Link sampler**, a tutorial package in Pascal for the Apple II. Floppy disk, \$60. Link Systems (see address above).

**Linkvideo**, a screen utility in Pascal for the Apple II. Floppy disk, \$55. Link Systems (see address above).

**Red Alert**, an arcade-style game for the Apple II Plus. Floppy disk, \$29.95. Bröderbund Software Inc., 2 Vista

Wood Way, San Rafael, CA 94901.

**Shadow Hawk One**, an arcade-style game for the Apple II. Floppy disk, \$49.95. Horizon Simulations, 107 East Main #2, Medford, OR 97501.

**Zoom Grafix**, a graphics/prINTER control package for the Apple II. Floppy disk, \$39.95. Phoenix Software Inc. (see address above).

## Atari

**Easytext Word Processor**, a word-processing system for the Atari 800. Floppy disk, \$50. Dataworks Inc., 97 Jackson St., Cambridge, MA 02140.

**The I Ching**, a program for casting and displaying hexagrams for the Atari 800. Floppy disk, \$44.95. Alternate Reality Software, 2111 West Arapahoe Dr., Littleton, CO 80120.

**Shadow Hawk One**, an arcade-style game for the Atari 400/800. Floppy disk, \$49.95. Horizon Simulations, 107 East Main #2, Medford, OR 97501.

## CP/M

**Office System 80**, a utility system for the CP/M operating system. 8-inch floppy disk, \$195. The Information People, 443 Hudson Ave., Newark, OH 43055.

**Quickscreen**, a screen-formatting program for the CP/M operating system. 8-inch floppy disk, \$149. Fox and Geller Associates Inc., POB 1053, Teaneck, NJ 07666.

**The Formula**, a multifunctioned, business-oriented data-processing package for CP/M. 8-inch floppy disk, \$595. Dynamic Microprocessor Associates, 545 5th Ave., New York, NY 10017.

**XLT86**, an assembly-lan-

guage conversion utility to convert CP/M programs to CP/M-86. 8-inch floppy disk, \$150. Digital Research Inc., 801 Lighthouse Ave., POB 579, Pacific Grove, CA 93950.

## TRS-80

**LOG**, a simple database management program for the TRS-80 Models I and III. Floppy disk, \$44.95 (Model I), \$49.95 (Model III). KSoft, 318 Lakeside Dr., Brandon, MS 39042.

**Modem 80**, a telecommunications software package for the TRS-80 Models I and III. Floppy disk, \$39.95. The Alternate Source, 1806 Ada St., Lansing, MI 48910.

**Smart Terminal**, a telecommunications software package for the TRS-80 Models I and III. Cassette, \$69.95.

Howe Software, 14 Lexington Rd., New City, NY 10956.

**Uniterm**, a telecommunications software package for the TRS-80 Models I and III. Floppy disk, \$29.95. BT Enterprises, 171 Hawkins Rd., Centereach, NY 11720.

## Other Computers

**Quadcube**, an extended graphics simulation of the Rubik cube puzzle for the Texas Instruments TI-99/4. Cassette, \$14.95. Linear Aesthetic Systems, POB 23, West Cornwall, CT 06796.

**The ZX80 Business Package**, a business-oriented program package for the ZX80 and MicroAce computers. Cassette, \$9.95. Lamo-Lem Laboratories, POB 2382, La Jolla, CA 92038. ■

This is a list of software packages that have been received by BYTE Publications during the past month. The list is correct to the best of our knowledge, but it is not meant to be a full description of the product or the forms in which the product is available. In particular, some packages may be sold for several machines or in both cassette and floppy-disk format; the product listed here is the version received by BYTE Publications.

This is an all-inclusive list that makes no comment on the quality or usefulness of the software listed. We regret that we cannot review every software package we receive. Instead, this list is meant to be a monthly acknowledgment of these packages and the companies that sent them. All software received is considered to be on loan to BYTE and is returned to the manufacturer after a set period of time. Companies sending software packages should be sure to include the list price of the packages and (where appropriate) the alternate forms in which they are available.

## BYTE's Bugs

### Closer Look Spies Bug

*PC: The Independent Guide to the IBM Personal Computer* is a bimonthly publication, not a monthly as stated on page 60 of Gregg Williams' article "A Closer Look at the IBM Personal Computer" (January 1982 BYTE). Subscriptions to the

magazine cost \$12 for six issues.

Please note that the new address for *PC: The Independent Guide to the IBM Personal Computer* is 1239 21st Ave., San Francisco, CA 94122, (415) 753-8088. ■



# Ask BYTE

Conducted by Steve Ciarcia

## Speech Synthesizer Application

Dear Steve,

I read with great interest your article, "Build an Unlimited-Vocabulary Speech Synthesizer" (September 1981 BYTE, page 38), and have found a possible use for it. I have a Perkin-Elmer 3220 computer and would like to use the synthesizer to answer telephone calls into the computer, mainly to respond to salesmen who have phoned orders into the computer. The synthesizer would respond with appropriate messages, telling the salesmen if transmission was successful or what problem occurred. Could the synthesizer feasibly be used in this capacity on my computer, with or without modifications, and what modifications would be necessary, if any?

**Derek Pitcher**  
Highland Park, NJ

*The speech synthesizer requires only a Centronics-compatible parallel output port commonly used for printers. The port comprises 9 output lines and 2 input lines. If your computer has this capability, then the synthesizer can be easily interfaced as described in the article.*

*Your application is an excellent one. Many companies, including Ma Bell, use speech synthesizers on the telephone. Listen carefully the next time you dial a phone number that has been charged. . . . Steve*

## Problems with EPROM

Dear Steve,

I was very glad to see your

article, "Build an Intelligent EPROM Programmer," in the October 1981 BYTE (see page 36). For the past several months, I have been trying to build a circuit to program EPROMs (erasable programmable read-only memory) using my homebrew 6809 computer and three output ports from 6820 Peripheral Interface Adapters. It was a bit of a surprise to see that my circuit is almost the same as yours. Mine does not work, however, and I can't figure out why.

I am using the 5-volt-only version of the 2716 EPROM, and my timing is done by a wait loop in software rather than by the one-shot TTL (transistor-transistor logic) device that you used. When I try to program a "known-good" 2716, it comes out with about one-fourth the bytes programmed (the rest are hexadecimal FF), and those bytes that are programmed are not necessarily right.

I checked all the address lines and data lines over and over again. I even single-stepped through the program, monitoring all the voltages as I went. Every pin is what it should be, but it just doesn't work right. I was wondering if you knew of any little idiosyncrasies of the 2716 that may cause such a symptom. Did you run into any such trouble with your circuit?

**Matthew G. Cimbala**  
State College, PA

*It sounds as if you have a software problem in which the addresses are not being placed on the EPROM in the right sequence. Perhaps your address-incrementing routine is resetting too soon.*

*The fact that you are getting data into the EPROM*

*(assuming that all bytes were hexadecimal FF prior to programming) indicates that the program timing loop is okay. The 2716 is a very reliable EPROM and I am not aware of any idiosyncrasies that would cause this problem. I suggest you leave it alone for a few days and then walk through the software, paying close attention to your indexing instructions. . . . Steve*

## Modem Interface

Dear Steve,

I acquired an acoustically coupled modem made by Multi-tech Systems from New Brighton, Minnesota. This is the model FM 30; it has a full- or half-duplex switch on the bottom and also what appears to be an RS-232C input connector. I was wondering if you could provide any information on interfacing this with my Apple II Plus. Would one of the commercial interfaces work, such as the Apple Communications board or Mountain Computer's CPS Multifunction card? Any information would be greatly appreciated.

**Steven M. Babick**  
Dolton, IL

*Any board that provides an RS-232C serial input will be adequate to interface your modem to the Apple II Plus. The commercial interfaces that you mentioned are fine for this purpose.*

*For an explanation of how modems work, and some of the terminology associated with them, refer to my article, "A Build-It-Yourself Modem for Under \$50," in the August 1980 BYTE, page 22. . . . Steve*

## High-speed Printers

Dear Steve,

I would like to build a 16-bit microcomputer system to drive a 600-line-per-minute printer. Printers like that are advertised in BYTE, but I have my doubts that anything can actually print at that speed. What do you think?

**Colin Morris**  
New York, NY

*Six-hundred-line-per-minute printers do indeed exist. Your doubts as to anything printing that fast are natural, especially if you are used to seeing a dot-matrix or daisy-wheel printer printing one character at a time. The higher-speed printers print a whole line at a time (like the old mechanical adding machines) and can be driven much faster.*

*I think the ultimate in printers is the IBM laser printer. It is capable of 1800 lines per minute. It works by having the laser, acting like the electron beam of a TV screen, scan a metal plate. The plate becomes charged, and the image is transferred to paper much like a xerographic photocopier. The problem with this type of printer is the manpower necessary to load and unload the boxes of paper that are used. . . . Steve*

## Level I Tape Format

Dear Steve,

I wrote a program that brought data from the tape and stored them in memory of my TRS-80 Model I so that I could examine them. But the data format did not match any listed in my refer-



ences. Part of the problem was that I was using a Level I BASIC machine and reading programs like Eliza, Micro-movie, and Pyramid 2000.

So I modified my program to read Level II tapes and sure enough, the formats were correct. Can you tell me where to find the format for Level I tapes?

**Bob Fabiano**  
El Cajon, CA

*Radio Shack has machine-language programs for converting your Level I BASIC programs and data files into the Level II format. They are called CONV and DCONV, respectively, and are furnished free of charge when a Level I machine is upgraded to Level II. See your local Radio Shack dealer.*

*The Level I cassette-tape format can be found in The Custom TRS-80 and Other Mysteries by Dennis Kitz.*  
... Steve

### Computer Lab Essentials

Dear Steve,

I am a sometime practitioner of simple chip and micro-processor designs. I am approaching retirement in a few years and I'd like to build more ambitious projects. To do that I'd like to set up a lab of sorts. Accordingly, I would value your recommendations about the kinds of test instruments I should be thinking about getting. I should tell you also that I have a 35-year-old degree in electrical engineering and, in the mid-fifties, I worked in hardware. The point being I'm not worried about my ability to use dual-trace scopes, voltmeters, and the like.

I'll probably try to build a computer from scratch. I was particularly intrigued by your article, "Build a Computer-Controlled Tank," in the February 1981 BYTE, page 44. Maybe I'll try to tie a specially built computer to a complex model railroad layout. I tell you this to give you an idea of what I think I'd like to do. I'm not especially worried about the price of the test instruments, but naturally I'd like to avoid buying the fanciest Tektronix scope. I'm an experienced kit builder, so if you think a particular Heath scope is a good value and desirable, that might be best.

**B. H. Kramer**  
St. Louis, MO

*The two instruments that are absolute musts for a computer lab are an oscilloscope and a DVM (digital voltmeter). The 'scope should have a 15 to 25 MHz bandwidth with dual trace and a time-base range between 200 nanoseconds and 0.5 seconds (without having to use the time-base magnifier). Vertical sensitivity should be at least 10 millivolts per division. Delayed sweep and trigger view are not necessary. I just purchased a Tektronix 2215 (\$1400), and it is very good for the money. As for the DVM, any 3½ digit model should suffice.*

*Other useful equipment would be a function generator and variable-voltage power supply with short-circuit and overload protection.*

*The above recommendations should suffice for the application that you describe. In any event, this represents the foundation of a good lab system and will require only a modest investment. Enjoy your retirement. ... Steve*

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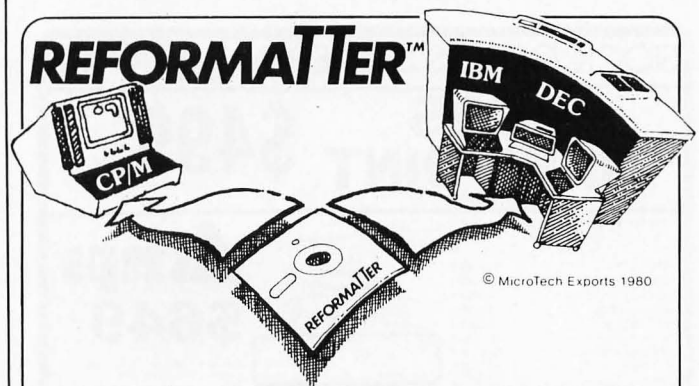
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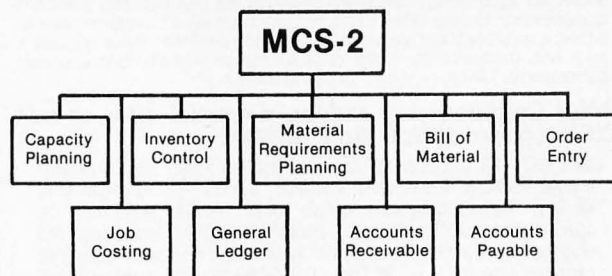
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## Ask BYTE

### Programming the RS-232C Serial Port

Dear Steve,

I have been unable to find any information on programming the RS-232C serial port on the Radio Shack Color Computer. A call to the "hot line" indicated that Radio Shack consultants were somewhat in the dark, although they tried to be helpful. Can you shed any light on this topic?

**Martin F. Rooney**  
Troy, NY

The RS-232C serial port on Radio Shack's Color Computer consists of 3 bits of 3 addresses of a Motorola MC6821 Peripheral Interface Adapter (PIA). At address hexadecimal FF20, bit 1 represents the RS-232C Data Output and is brought out to pin 4 of connector P2. Address hexadecimal FF21, bit 1, is the Status Input line, connected to pin 1 of P2. Address hexadecimal FF22, bit 0, is the RS-232C Data Input and is connected to pin 2 of P2; pin 3 of P2 is ground.

In software, the only RS-232C device supported by the 8K-byte BASIC is a serial printer, so pin 1 of P2 is not used. Pin 2 is intended to be connected to the printer status or busy line, and pin 4 is the output to the printer. To program the MC6821, a rather elaborate discussion must ensue. An article from EDN magazine, September 20, 1980, "Understanding PIA Operations Increases Your Design Options" by Randy Hutcheson, explains this rather well.

The TRS-80 Color Computer Technical Reference Manual (Cat. No. 26-3193) explains all the input/output ports and has a complete memory map. It is available through any Radio Shack store. . . . Steve

### Build Your Own

Dear Steve,

I have read some of your articles and especially liked "Build the Disk-80" (see the March 1981 BYTE, page 36), but I was sorry that it was not designed to work with 8-inch disk drives. I would like to build a computer, perhaps based on Zilog's Z80, with provisions for four 8-inch disk drives and with the ability to directly address 128K bytes of nonvolatile memory. Do you have any suggestions?

**W. Edward Kelsey**  
New London, NH

I'm glad to see that there are still some people who enjoy building computers rather than buying them. Your idea of a Z80-based system sounds fine, but I don't plan anything like it in the near future. Below are a few suggestions that may help.

You don't say what your experience level is, but at the risk of sounding like a commercial I would recommend my book, Build Your Own Z80 Computer (a McGraw-Hill publication available from BYTE Books, Peterborough, NH 03458). It contains the necessary information to build a complete computer and configure it any way that you wish.

As for the disk controller and memory, I would suggest that you buy them either as bare boards or assembled and tested. Configure your Z80 to an S-100 bus and save yourself a lot of grief. You will have your fun building the Z80 and you will save a lot of headaches by using prewired boards for the rest of the system.

You then can use bank-selectable memory boards and can easily have your 128K bytes of memory. . . . Steve

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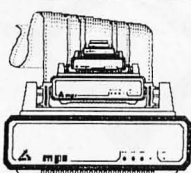
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### Radio Frequency Interference

Dear Steve,

I have been reading your column in BYTE since I first picked up an issue about four months ago. I am writing this on my newly acquired Vector Graphic System B and would deeply appreciate a reply to a nagging question.

The Vector System B installed for word processing in my home is about 15 feet from our TV antenna (located on rafters in the garage—our elevation precludes an external antenna). The system kills channel 2 and distorts 5 and 7. The dealer suggested a Radio Shack filter, which did nothing. I learned from another dealer that the System B uses a crystal oscillator with a frequency near television channel 2.

Please suggest what course of action I should take or what remedies I might initiate myself, such as a radio-frequency filter a novice could install in or around the computer case.

Jacob D. Pottgen  
New Lenox, IL

*I'm glad to hear that you've been reading my column for the past four months. Had you read the January 1981 BYTE on page 48, you would have seen my article on "Electromagnetic Interference." After reading it, you should have enough information to solve your radio-frequency interference problems.*

*It is important to understand what causes the problem and to recognize that it is difficult to determine what may be radiating the interfering signal. . . . Steve*

### Plotting with the TRS-80

Dear Steve,

I would like to find a program that will allow me to make x-y plots of graphs of linear and logarithmic equations and data points. I have a TRS-80 Model III and an IDS-560 printer with graphics capability. I don't need to see the plots on the screen; I only need to be able to print them out on the IDS-560.

Any help you could give me would be most appreciated. Thanks a lot.

Donald M. Lammers  
Wexford, PA

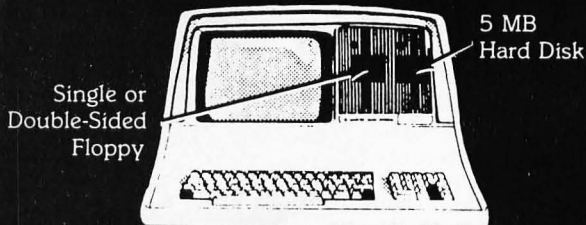
*Programs for x-y plotting are available at your local Radio Shack store. The following two books are quite thorough in the explanation of equations and data points and are directed, naturally, toward Radio Shack BASIC: TRS-80 Programs, Cat. No. 62-2064, and TRS-80 Graphics, Cat. No. 62-2063. . . . Steve*

### A Matter of Environment

Dear Steve,

I've taken instructions from a page from your recent book, *Build Your Own Z80 Computer*, and modified them to "Build Your Own Z8000," which is the source of my problem. The S-100 system I'm designing uses a Zilog Z8001 segmented microprocessor with a 4 MHz 9511 arithmetic processor. Hardware design is a snap so far. (I plan to purchase the Disk-1 floppy-disk controller from Godbout and build all other boards that I need.) The problem will be software; specifically, I need an operating system such as Unix or Unix-compatible Coherent. But Coherent is written in unsegmented code.

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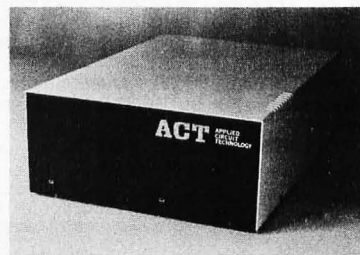
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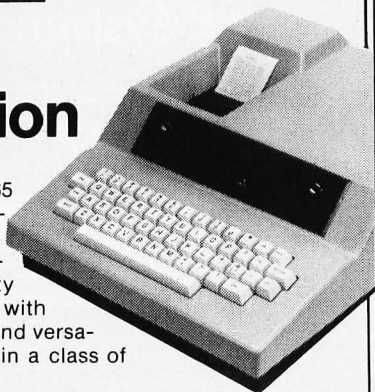


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## Ask BYTE

Where can I get an operating system?

This sort of operating system is not the type usually advertised in BYTE; and you know how much good my beautiful hardware is going to be without it. (I'd prefer Unix if available.) The computer is intended as a multi-user, multitasking system, preferably with a FORTRAN compiler, as well as an assembler/editor/debugger.

**Frank Barresi**  
Woodhaven, NY

*Your problem is somewhat sticky. The problem is not altogether in the operating system. Unix, like CP/M, does not contain the primitives (software subroutines) for any I/O (input/output). Like CP/M's BIOS (basic input/output subsystem), these are totally hardware dependent.*

*In other words, you might be able to use Unix if you can write the subroutines for the I/O primitives. Be wary, however; Unix may use some strange hardware-dependent software, but I'm not an expert on Unix and can't be sure of this.*

*Two good sources of information about Unix are: The July-August 1978 issue of the Bell System Technical Journal, devoted to Unix, available for \$2.98 from Bell Laboratories Circulation Group, Whippany Road, Whippany, NJ 07981; and Using the Unix System by Richard Gauthier, Reston Publishing Co., Reston, VA, 1981.*

*Get as much information on Unix as you can and study the various implementations of Unix. Pay special attention to system environmental requirements and I/O requirements.*

*What it all boils down to is this: if you can make your hardware as much like the proper environment for Unix as possible, it should work. (By the way, I'll let you know when I do anything with the*

*Z8000. Remember what happened to Colossus in the sequel?) Good luck in any event. . . . Steve*

## Feasibility Study

Dear Steve,

I am presently studying electronics at a technical school. I have a technical writing course in which we are assigned to do some sort of feasibility study. I have chosen to do mine on the feasibility of purchasing a microcomputer for home use.

I am hoping that you could give me some references and, if possible, pass along some information which would help me in my study. This would be most appreciated.

**Douglas E. Sprague**  
Hancock, ME

*There is a wealth of information available on purchasing a computer for home use. The field of home computing is rapidly expanding and makes an excellent choice for a feasibility study.*

*The following are some references that should be quite helpful: Popular Computing, November 1981; Personal Computing—Home Professional and Small Business Applications by Daniel R. McGlynn, John Wiley and Sons, 1979; and Your Own Computer by Mitchell Waite and Michael Pardee, Howard W. Sams & Co. . . . Steve*

## VIP Expansion

Dear Steve,

I have an RCA COSMAC VIP with the 20K-byte memory upgrade so that I can use the VIP Floating Point (VIP 711). What I would like to do is add a printer. Is it possible to do this with the VIP 711? I



know very little about the 1802 microprocessor.

I also have a TRS-80 with 48K bytes of memory, one disk drive, and a printer, and I have a Quick Printer 2. I would like to hook up the Quick Printer 2 to the VIP, but I don't even know how to start. I have no knowledge of electronics at all. Is this project possible? If so, where would I get the driver for the printer? (I have looked for 1802-based software to drive a printer, but so far, no soap.) Can you help me?

Nicholas Mulchin  
Meadville, PA

The RCA COSMAC VIP is a powerful single-board computer. Unfortunately, there is little support for it in the computer magazines. It does, however, have expansion capability in the form of a 44-line I/O (input/output) interface that will allow almost anything to be added, including up to 32K bytes of programmable memory. It requires a fair amount of technical skill to accomplish the interface.

I doubt if there exists a printer interface such as you are looking for that would simply "plug in" to your VIP. The two manufacturers listed below make interface boards for the 1802 processor, and they may have the necessary information to connect with the VIP: Netronics Research & Development, Ltd., 333 Litchfield Road, New Milford, CT 06776, (203) 354-9375; and RCA Solid State, Box 3200, Somerville, NJ 08876.

Any software must first test the "printer busy" signal. If it is active, the computer must not send data to the printer, or it will not be seen. When the busy signal is low, the 8-bit data character may be sent from the output port

which will cause the printer to print it. When the next character is ready, the process must begin again. . . . Steve

### TTL Data Books

Dear Steve,

I am looking for a TTL (transistor-transistor logic) data book that has descriptions and pinouts for the majority of the manufactured ICs (including the special and less frequently used ICs). Your suggestions are appreciated.

Paul Russo  
Naples, FL

Every manufacturer of integrated circuits publishes a data book for its product line. One of the most readily available data books is published by National Semiconductor and is available at your local Radio Shack store or through Jameco Electronics, 1355 Shoreway Rd., Belmont, CA 94002, (415) 592-8097. Price lists for various data books can also be obtained by writing directly to the manufacturers.

. . . Steve ■

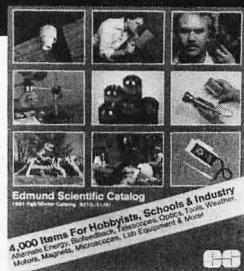
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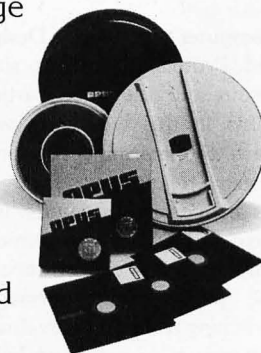
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# Event Queue

## March 1982

### March

**Courses and Seminars from George Washington University**, Amsterdam, Netherlands; London, England; Long Island, NY; San Diego, CA; and Washington, DC. Among the courses and seminars to be presented are "Microcomputers in Control Systems," "Comparative Database Management Systems," and "Structured Programming and Software Engineering." For further information, contact The Director, Continuing Engineering Education, George Washington University, Washington, DC 20052, (800) 424-9773; in Washington, DC, (202) 676-6106.

### March

**Courses in Structured Systems**, various sites throughout the U.S. Courses in "Structured Systems Design" and "Structured Requirements Definition" are being offered by Ken Orr and Associates. For information on meeting times, places, and fees, contact Ken Orr and Associates Inc., 715 East 8th, Topeka, KS 66607, (800) 255-2459; in Kansas (913) 233-2349.

### March-April

**Computer Network Design and Protocols**, various sites throughout the U.S. Participants in this workshop will learn to determine network-system requirements and to perform design trade-offs, implement network-communication and control protocols, use packet- and message-switching techniques, evaluate network hardware and software components, interface local systems to networks, and design and build private networks. The course fee is

\$845. Contact Ruth Dordick, c/o Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, (800) 352-8251.

### March-April

**Fundamentals of Data Processing for Administrative Assistants and Office Support Staff**, various sites throughout the U.S. The American Management Associations (AMA) has designed this three-day course for secretaries, assistants, supervisors, and other personnel desiring to learn the fundamentals of data processing and its use in offices. Computer hardware, software, programming languages, and technology will all be covered. The team fee for AMA members is \$470 per individual and \$550 for nonmembers. Individual fees are \$550 for AMA members and \$630 for nonmembers. For a schedule of dates and locations, contact the AMA, 135 West 50th St., New York, NY 10020, (212) 586-8100. To register by phone, call (212) 246-0800.

### March-May

**Courses from Boeing Computer Services**, various sites throughout the U.S. Boeing Computer Services is offering a wide variety of computer-related courses at its regional service centers. Course topics range from "Introduction to Data Processing" to "Structured Program Development in FORTRAN." For a complete schedule of times, locations, and fees, contact Boeing Computer Services Co., Education and Training Div., POB 24346, Seattle, WA 98124, (206) 575-7700.

### March-May

**Seminars and Conferences**

from Datapro Research, various sites throughout the U.S. Among the topics to be presented are "IBM's Systems Network Architecture," "Data Dictionary/Directory Systems," and "Data Processing: Fundamental Concepts." Enrollment fees are \$640 for Datapro subscribers and \$690 for nonsubscribers. For a complete catalog with descriptions, dates, and locations, contact Datapro Research Corp., 1805 Underwood Blvd., Delran, NJ 08075, (800) 257-9406; in New Jersey, (609) 764-0100.

### March-June

**Datamation Institute Seminars on Information Management**, various sites throughout the U.S. Databases and communications, systems performance, data-processing management, word processing, office automation, computer graphics, and topics of general interest are among the areas to be covered by these two-day seminars. Fees range from \$495 to \$595. For schedules of times and places, contact Karen Smolens, c/o the Center for Management Research, Datamation Institute Seminar Coordination Office, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020.

### March-June

**National Computer Graphics Association Seminar**, various sites throughout the U.S. The National Computer Graphics Association's (NCGA) Winter/Spring 1982 Seminar program covers such topics as "Computer Graphics: Technology and Applications," "Successful Business Graphics," and "Applications of Computer Graphics to Transportation Problems." Seminar fees are \$395 for association

members and \$425 for nonmembers. For complete details, contact Eloise Wenker, NCGA Seminar, 2033 M St. NW, #300, Washington, DC 20036, (202) 466-4102.

### March-June

**Intensive Two-day Seminars for Professional Development**, various sites throughout New England. Among the seminars to be offered by Worcester Polytechnic Institute are "Fundamentals of Data Processing," "Distributed Systems: The Architecture and Utilization of this Revolutionary Technology," and "Microprocessors: Hardware, Software, and Applications." Registration fees range from \$445 for a two-day program to \$990 for a 7-day executive institute. For complete details, contact Ms. Ginny Bazarian, Office of Continuing Education, Worcester Polytechnic Institute, Worcester, MA 01609, (617) 793-5517.

### March-June

**One- and Two-day Professional Development Seminars**, various sites in the greater Boston area. Among the courses being offered by Boston University are "Business Writing for Results," "Improving Customer Service," and "Assertive Management." Registration fees range from \$295 for a one-day program to \$445 for a two-day program. These seminars can be conducted within your company. For details, contact Ms. Joan Merrick, Center for Management Research, 850 Boylston St., Chestnut Hill, MA 02167, (617) 738-5020. For information on the in-company seminars, contact Ms. Elaine Dee at the same address.



March-June

**Courses and Seminars from Sira Institute**, various sites throughout England. Sira Institute is sponsoring seminars on a wide variety of subjects ranging from microprocessor familiarization to design and development of microprocessor-based equipment. For details, contact Conferences & Courses Unit, Sira Institute Ltd., South Hill, Chislehurst, Kent BR7 5EH, England.

March-July

**Technical Classes from Zilog**, Campbell, CA. Zilog is offering a series of one- to five-day technical classes at its California-based training facility. Topics range from "Microprocessors: A General Introduction" to "Zeus/System 8000 User." Contact Zilog, Training Dept., 1315 Dell Ave., Campbell, CA 95008, (408) 446-4666.

March 9-11

**The 1982 International Zurich Seminar on Digital Communications**, Zurich, Switzerland. The theme of this seminar is "Man-Machine Interaction." Its aim is to present recent advances in theory and application of digital-communication systems. Services, facilities, ergonomics, and their impact on peripheral equipment, systems architecture and design, as well as I/O (input/output) concepts and principles will be covered. For details, contact Secretariat '82 IZS, Ms. M. Frey, EAE, Siemens-Albis AG, POB CH-8047, Zurich, Switzerland.

March 9-11

**Understanding and Using Computer Graphics**, Dallas Hilton Inn, Dallas, TX. This seminar is designed for those needing information about interactive computer graphics, including hardware, software, and applications. Headed by

Carl Machover, the seminar provides a comprehensive overview of the state of the art in graphics systems. For details, contact Bob Sanzo, c/o Frost & Sullivan Inc., 106 Fulton St., New York, NY 10038, (212) 233-1080.

March 9-12

**Digital Image Processing and Analysis**, San Diego, CA. Integrated Computer Systems' course in digital-image processing is designed for engineers, scientists, technical managers, and other professionals responsible for the specification, design, implementation, or application of digital-image processing systems. Among the topics to be covered are image acquisition, image-processing software and database structures, interactive two- and three-dimensional image processing and display, and real-time arrays. Some of the applications examples to be presented are quality assurance and robot vision. The course fee is \$795; on-site courses can be arranged. Contact Ruth Dordick, c/o Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, (800) 352-8251.

March 9-12

**VIO-Voice Input/Output for Computers**, Los Angeles, CA. This four-day course is designed for product development and design engineers, systems analysts, programmers, and technical managers involved in the planning, design, and implementation of voice input/output systems. The topics to be covered include voice-processing algorithms and software, evaluating VIO hardware components and systems, utilizing speech-synthesis techniques, and designing voice-recognition techniques. Participants

will have the opportunity to work with devices that permit online generation of computer-voice output, data entry by means of voice input, and voice input for system control. The course fee is \$795; on-site courses can be arranged. For information, contact Ruth Dordick, c/o Integrated Computer Systems, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California (800) 352-8251.

March 10-12

**Cincinnati Business Show**, Cincinnati Convention Center, Cincinnati, OH. The Cincinnati Business show features the latest in business technology, office systems, and products. Seminars will also be presented. For information, contact Ray G. Nemo, 5679 Creek Rd., Cincinnati, OH 45242, (513) 531-5959.

March 12-13

**The Fifth Annual Computers in Education Conference**, Seattle Pacific University, Seattle, WA. Sponsored by Seattle Pacific University and the National Council for Computers in Education, this conference features concurrent talks, workshops, and discussions. Special emphasis will be placed on curricular uses of microcomputers in kindergarten through 12th grade. Contact Tony Jongejan, Everett High School, Everett, WA 98201.

March 12-14

**FantasyLair '82**, Ponca City, OK. The Northern Oklahoma Dungeoneers will be sponsoring tournaments and games in role-playing, war simulation, and many other card and board games. Admission is \$10 per day. Contact Shelby Cooper, c/o Northern Oklahoma Dungeoneers, POB 241, Ponca City, OK 74602, (405) 762-6077.

March 15-17

**Microprocessor Background for Management Personnel**, Albuquerque, NM. This course is sponsored by the Electrical and Computer Engineering Department of the University of New Mexico. The course fee is \$375. For details, contact Dr. Martin Bradshaw, Engineering Continuing Education, University of New Mexico, Albuquerque, NM 87131, (505) 277-4354.

March 15-19

**Short Course from UCLA**, Boelter Hall, University of California-Los Angeles (UCLA), Los Angeles, CA. "Mechanical Reliability, Design by Reliability, Probabilistic Design—The Stress/Strength Interference Approach to Reliability Prediction" is a short course being presented by UCLA. The course fee is \$795, which includes comprehensive course notes. For details, contact Dr. Dimitri Kececioglu, Aerospace and Mechanical Engineering Dept., University of Arizona, Tucson, AZ 85721, (602) 626-2495 or (602) 626-3901. In California, call Robert Rector at UCLA, (213) 825-1295 or (213) 825-3334.

March 16-18

**Software/expo-West**, Anaheim Convention Center, Anaheim, CA. This conference and show is devoted to packaged software. Exhibitors will display a wide range of software products. For additional information, contact Software/expo-West, Suite 400, 222 West Adams St., Chicago, IL 60606, (312) 263-3131.

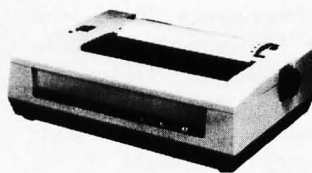
March 16-19

**Digital Filters and Spectral Analysis**, Boston, MA. Integrated Computer Systems (ICS) is presenting this four-day course for project and design engineers, programmers, and technical managers responsible for implementing



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Apple Version	List Price	Our Price
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SpellStar	200.00	120.00
DataStar	295.00	177.00
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**Event Queue**

advanced digital signal-processing systems and for others who must understand them and their potential. Fundamentals of digital signal processing, fast Fourier transform (FFT) algorithms, and special- and general-purpose LSI/VLSI (large-scale and very large-scale integration) devices are among the topics to be addressed. The course fee is \$795; on-site courses can be arranged. Contact Ruth Dordick, c/o ICS, 3304 Pico Blvd., POB 5339, Santa Monica, CA 90405, (800) 421-8166; in California, (800) 352-8251.

March 17

**Evaluating Decision Support Software: A Managerial Perspective,** Suffolk University School of Management, Boston, MA. This conference is sponsored by the local chapters of six management and computer associations. It will examine the managerial issues involved in choosing decision-support software. The focus will be on end-user characterization, problem diagnosis, needs assessment, and the implications of the evaluation and selection process. Industry experts will speak. Contact DSS Conference, 215 First St., Cambridge, MA 02142, (617) 547-5061.

March 19

**The Eleventh Annual International Computer Programs Awards Ceremony and Executives' Conference,** Savoy Hotel, London, England. The annual International Computer Programs (ICP) awards ceremony honors super software salespeople, advertising agencies, public relations firms, and achievements in the industry. The executive conference is one and a half days of discussion of the major issues and concerns of the industry. The fee for the executive conference is \$250. For information, contact Carol

Stumpf, c/o ICP, 9000 Keystone Crossing, POB 40946, Indianapolis, IN 46240, (800) 428-6179; in Indiana, (317) 844-7461. In England, contact International Computer Programs Inc., 2 Deanery St., Park Lane, London W1Y 5LH, England, Tel: 01 499 6621.

March 19-21

**The Seventh West Coast Computer Faire,** Civic Auditorium and Brooks Hall, San Francisco, CA. Attendance this year is expected to reach 35,000. More than 300 exhibitors and a wide assortment of seminars make this one of this largest annual computer shows. For more information, contact The Computer Faire, 333 Swett Rd., Woodside, CA 94062, (415) 851-7075.

March 22-23

**Oasis Level Two Training Seminars,** Phase One Systems, Oakland, CA. Using a step-by-step approach to developing applications software with the multiuser Oasis operating system, this seminar begins with program design and proceeds to a careful study of the Oasis system. Topics to be covered are the Oasis BASIC interpreter and compiler, program segments, file structures and I/O (input/output), matrices and matrix I/O, multiline branching structures, and subroutine and error handling.

The registration fee for this three-day session is \$350. Some background in BASIC programming is recommended. Contact Phase One Systems, Suite 830, 7700 Edgewater Dr., Oakland, CA 94621, (415) 562-8085.

March 22-25

**Interface '82 Conference and Expo,** Dallas Convention Center, Dallas, TX. Cosponsored by McGraw-Hill's *Business Week* and *Data Communications* magazines, Inter-



face '82 is aimed at users of data-communication equipment, distributed-data processing, and various networks. For details, contact The Interface Group, 160 Speen St., POB 927, Framingham, MA 01701, (800) 225-4620; in Massachusetts, (617) 879-4502.

March 22-26

**Computers/Graphics in the Building Process**, Washington, DC. This international conference is sponsored by the Advisory Board on the Built Environment (ABBE) of the National Academy of Sciences and by the World Computer Graphics Association (WCGA). The conference features tutorials, technical paper sessions, and exhibits that reflect the state of the art of computers and computer-graphics technology in the building industry. Sessions on case studies, current achievements, and research and development of computer hardware, software, and database programs will be presented. Conference topics include computer aids to management, computer technology, and computer-aided analysis in design development and construction documents. For further details, contact the WCGA, Suite 250, 2033 M St. NW, Washington, DC 20036, (202) 775-9556.

March 22-26

**Tutorial Week East '82**, Orlando Marriott Inn, Orlando, FL. Tutorial Week East is sponsored by the Institute of Electrical and Electronics Engineers (IEEE) and will consist of 15 tutorials arranged in three tracks: VLSI (very large-scale integration) microprocessor interfacing techniques and graphics; aspects of software design, analysis, and techniques; and data communications, computer networking, and databases. Fees are \$90 per tutorial, \$400 all

week, for IEEE members, and \$110 per tutorial, \$500 all week, for nonmembers. For information, contact Tutorial Week East '82, POB 639, Silver Spring, MD 20901, (301) 589-3386.

March 23-25

**Southcon '82**, Sheraton Twin Towers Hotel, Orlando Hyatt Hotel, and Holiday Inn International Drive, Orlando, FL. Among the topics to be presented at Southcon '82 will be artificial intelligence and robotics, office automation, computers and microprocessors, and software. For complete details, contact Robert Myers, c/o Electronic Conventions Inc., Suite 410, 999 North Sepulveda Blvd., El Segundo, CA 90245, (213) 772-2965.

March 26-28

**The 1982 Computer Showcase Expo**, Atlanta, GA. The Computer Showcase is designed for small-business owners, independent professionals, and corporate managers. Admission is \$7.50. For further details, contact The Interface Group, 160 Speen St., POB 927, Framingham, MA 01701, (800) 225-4620; in Massachusetts, (617) 879-4502.

March 27-28

**Amateur Radio and Computer Hobbyists (ARCH) Convention**, Chase Park-Plaza Hotel, St. Louis, MO. This convention features exhibitions, workshops, forums, and a flea market. For details, contact Gateway Amateur Radio Association, POB 8432, St. Louis, MO 63132, (314) 361-4965.

March 29-30

**Information Utilities '82**, Rye Town Hilton Hotel and Conference Center, Rye, NY. The Information Utilities conference will focus on videotex, transactional services, elec-

tronic publishing, online database services, cable advertising, and regulations concerning copyright, censorship, and communications. More than 60 speakers are scheduled. For details, contact Online Inc., 11 Tannery Ln., Weston, CT 06883, (203) 227-8466.

March 29-April 1

**INFOCOM '82**, Las Vegas, NV. INFOCOM '82 is sponsored by the Institute of Electrical and Electronics Engineers (IEEE) Computer and Communications Societies. The conference theme is "Data Processing—Data Communications: The Illusory Boundary." Focusing on the convergence of computer and communication technology, this conference will attempt to bridge the boundary between the two disciplines. Discussions on programming-language and operating system

design, performance evaluation and analysis of computer-communication networks and protocols, standards, and the design of distributed computing and database management systems will be held. Exhibits and tutorials are planned. Write to INFOCOM '82, POB 639, Silver Spring, MD 20901, (301) 589-3386.

March 30-April 2

**Digital Image Processing and Analysis**, Washington, DC. For details, see March 9-12.

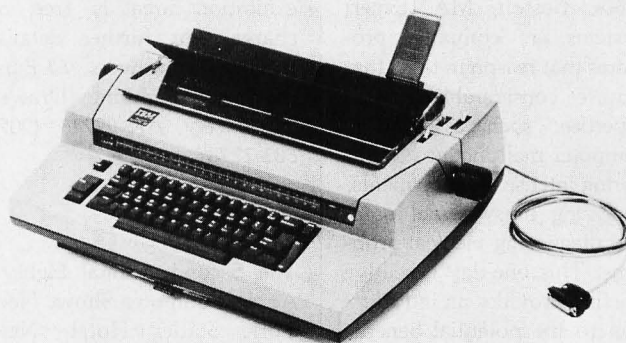
## April 1982

April

**Courses from George Washington University**, Hampton, VA; Salem, NH; Washington, DC; London, England; and Berlin, West Germany.

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Among the courses scheduled are "Voice Input/Output," "Microwave Systems Planning," "Writing Professional and Technical Communications," and "Computer Graphics Systems: Design and Applications." For further information, contact Continuing Engineering Education, School of Engineering and Applied Science, George Washington University, Washington, DC 20052, (800) 424-9773; in the District of Columbia, (202) 676-6106.

*April*

**Courses in Structured Systems**, various sites throughout the U.S. "Structured Systems Design," "Structured Requirements Definition," and "Management Overview of Data Structured Systems Development" are being offered by Ken Orr and Associates. For information on meeting times, places, and fees, contact Ken Orr and Associates Inc., 715 East 8th, Topeka, KS 66607, (800) 255-2459; in Kansas, (913) 233-2349.

*April*

**Knowledge Engineering in the 1980s**, Boston, MA. Expert Systems are computer programs that reason in tasks that require considerable human expertise, such as locating computer malfunctions, monitoring intensive-care patients, analyzing noisy signal data, and diagnosing medical problems. This one-day executive briefing provides an introduction to the potential benefits and costs of Expert Systems. For further information, contact Dina Barr, c/o Teknowledge, 151 University Ave., Palo Alto, CA 94301, (415) 326-6827.

*April 1-2*

**The Eleventh Annual International Computer Programs Awards Ceremony and Executive Conference**, Marriott

Mountain Shadows Resort, Scottsdale, AZ. The annual awards ceremony honors super software salespeople, advertising agencies, public relations firms, and microcomputer software achievements. The executive conference discusses the main issues and concerns of the industry, such as productivity through proper use of people and machines, new software-piracy solutions, and how to get the most out of advertising dollars. The fee for the executive conference is \$250. For detailed information, contact Carol Stumpf, c/o ICP, 9000 Keystone Crossing, POB 40946, Indianapolis, IN 46240, (800) 428-6179; in Indiana, (317) 844-7461.

*April 2-3*

**Educational Computing—The Future Is Now**, Anchorage, AK. The Educational Computing Conference is sponsored by the Alaska Association for Computers in Education. Invited speakers, exhibits, and demonstrations of microcomputer products for educational purposes will be featured. Admission to the exhibition area is free of charge. For further details, contact Pat Stowers, '82 Educational Computing, Drawer 129, Healy, AK 99743, (907) 683-2278.

*April 2-4*

**The Second Annual Eighty/Apple Computer Show**, New York Statler Hotel, New York, NY. The Eighty/Apple Computer Show features products and services for TRS-80 and Apple computer systems. More than 100 exhibitors of hardware, software, books, magazines, supplies, services, and accessories will attend. For more information, contact Kengore Corp., 3001 Rte. 27, Franklin Park, NJ 08823, (201) 297-2526.

*April 4-7*

**The Seventh Annual Deltak International Training Conference**, Access 82, Hyatt Regency, Chicago, IL. More than 1000 training and electronic data-processing professionals are expected to attend 35 workshop sessions. Former president Gerald R. Ford will deliver the keynote address. The registration fee is \$525. Information is available from Gail Bohan, c/o Deltak Inc., 1220 Kensington Rd., Oak Brook, IL 60521, (312) 920-0700.

*April 5-7*

**The Third Annual Office Automation Conference**, George R. Moscone Convention Center, San Francisco, CA. This conference is sponsored by AFIPS (American Federation of Information Processing Societies). Exhibits and workshops will be featured. For details, contact Betty Lou Cooke, c/o AFIPS, 1815 North Lynn St., Arlington, VA 22209, (703) 558-3612.

*April 6-8*

**The Sixth Annual Computerized Office Management Expo-Midwest '82**, O'Hare Expo Center, Chicago, IL. This conference and exhibition features business-oriented equipment for word and data processing, information management, record storage and retrieval, and micrographics. A three-day high-technology symposium, "Business Automation and Communications" will highlight Midwest '82. For details, contact Cahners Exposition Group, 222 West Adams St., Chicago, IL 60606, (312) 263-4866.

*April 13-16*

**Digital Image Processing and Analysis**, Boston, MA. For details, see March 9-12.

*April 14-18*

**Electronic Home Entertainment Show**, Arlington Park Race Track Exposition Hall, Arlington Heights, IL. This show will feature audio and video equipment, video games, home computers, and citizen-band radio systems. It will run concurrently with the Fourth Annual Energy & Home Improvement Faire. Contact Expo Management Inc., Suite S2-132 Arcade, The Apparel Center, Chicago, IL 60654, (312) 329-1191.

*April 15-17*

**The 1982 Computer Showcase Expo**, St. Louis, MO. For details, see March 26-28.

*April 15-18*

**The Second Southwest Computer Show and Office Equipment Exposition**, Market Hall, Dallas Market Center, Dallas, TX. This features mini- and microcomputers for business, education, government, industry, home, and personal use. Data- and word-processing equipment, office machines, computer peripherals, and office supplies will be displayed. General admission is \$5. Contact National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

*April 16-17*

**The Twelfth Annual Virginia Computer Users Conference**, Marriott Hotel, Blacksburg, VA. This conference is sponsored in cooperation with the ACM (Association for Computing Machinery). Topics of interest are artificial intelligence, office automation, and database management. Contact Deidre Maskaleris or Wesley Braudaway, 562 McBryde Hall, Virginia Polytechnic Institute & State University, Blacksburg, VA 24061, (703) 961-6931.

*April 19-21*

**Open Systems Interconnec-**



tion with X.25 and Other Related Protocols, Denver Marriott Hotel-City Center, Denver, CO. Sponsored by DataCommunications, a McGraw-Hill publication, this seminar will present a thorough treatment of the basic OSI (Ohio Scientific) Reference Model, describing the seven-layer structure, service definitions, and emerging protocols. Detailed presentations of the X.25 packet protocol will be included. The seminar fee is \$690. For further details, contact the McGraw-Hill Conference & Exposition Center, Rm. 3677, 1221 Avenue of the Americas, New York, NY 10020, (212) 997-4930.

April 20-22

D-COM, Hynes Auditorium, Boston, MA. D-COM will bring DEC (Digital Equipment

Corporation) vendors together with DEC users. For information, contact Ron Davies, D-COM Inc., 7312 Burdette Court, Bethesda, MD 20817, (301) 469-7650.

April 20-23

VIO—Voice Input/Output for Computers, Boston, MA. For details, see March 9-12.

April 21-28

Hanover Fair '82, Hanover, West Germany. The annual Hanover Fair is one of the world's largest industrial and trade exhibitions. More than 330 American firms are expected to exhibit products, services, and technology at the Fair. Contact M.A. Delia, Hanover Fairs Information Center, POB 338, Whitehouse, NJ 08888, (800)

526-5978; in New Jersey, (201) 534-9044.

April 22

California Computer Show, Hyatt Hotel, Palo Alto, CA. This show is for OEMs (original equipment manufacturers), knowledgeable users, distributors, and dealers. More than 60 computer manufacturers will be exhibiting mainframes, mini- and microcomputers, and peripherals. Contact Carol Reimer, c/o Norm De Nardi Enterprises, 289 South San Antonio Rd. #204, Los Altos, CA 94022, (415) 941-8440.

April 22-25

New York Computer Show and Office Equipment Exposition, Nassau Coliseum, Uniondale, NY. For details, see April 15-18.

April 23-25

The 1982 Computer Showcase Expo, Miami, FL. For details, see March 26-28.

April 24

Computer Swap America, Santa Clara County Fair Grounds, San Jose, CA. This high-technology flea market features everything from home satellite-receiving stations to floppy disks. Admission is \$3. Contact Computer Swap America, POB 52, Palo Alto, CA 94302, (415) 494-6862.

April 27-28

The Eighth Annual National Computer Security and Privacy Symposium: Top Secret '82, Washington, DC. Sponsored by Honeywell, approximately 22 national authorities on computer security and

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## Event Queue

privacy will speak on a variety of topics. Training workshops in security planning and risk analysis, disaster recovery and contingency planning, and computer fraud investigation will be held. The fee for the symposium is \$525; discounts on multiple registrations are available. Contact the Security Symposium Registrar, Honeywell Inc., M/S T-99-4, POB 6000, Phoenix, AZ 85005; or call Jerome Lobel, (602) 249-5370.

### May 1982

*May-June*

**Sensors & Systems '82**, various sites throughout the central and western regions of the U.S. This series of three-day conferences will cover all aspects of sensor technology from temperature sensors through to displacement, velocity, acceleration, magnetic field, and moisture. Other topics to be covered include signal conditioning, digital interfaces, and system interfaces. Contact Network Exhibitions, 785 Harriet Ave., Campbell, CA 95008, (408) 370-1661.

*May 6-9*

**The Southern California Computer Show & Office Equipment Exposition**, Los Angeles Convention Center, Los Angeles, CA. This show features mini- and microcomputers for business, education, government, industry, home, and personal use. Word- and data-processing equipment, office machines, and computer peripherals will be displayed. Admission is \$5. For details, contact National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

*May 7-9*

**The 1982 Computer Showcase Expo**, Anaheim, CA. For details, see March 26-28.

*May 10-12*

**Dexpo 82**, Marriott Hotel, Atlanta, GA. This exposition features DEC- (Digital Equipment Corporation) compatible hardware, software, and services. Contact Expoconsul International Inc., 19 Yeger Rd., Cranbury, NJ 08512, (609) 799-1661.

*May 10-14*

**The Twentieth Annual Convention of the Association for Educational Data Systems (AEDS)**, Sheraton Twin Towers, Orlando, FL. This convention includes presentations on the state of the art in educational computing. Administrative and instructional computing applications will be presented, and new ways of improving educational processes will be explored. Contact Shirley Easterwood, c/o AEDS, 1201 Sixteenth St. NW, Washington, DC 20036.

*May 14-15*

**The Second Annual Southern California Computers-in-Education Conference**, University High School, Irvine, CA. This conference covers the application of computers in education from kindergarten through two-year college. All areas of curriculum will be touched upon, including reading, mathematics, science, language, and special education. Hands-on workshops and field trips are planned. Contact Craig Walker, Arrowview Intermediate School, 2299 North G St., San Bernardino, CA 92405, (714) 886-9118.

*May 14-16*

**Applefest/Boston**, Hynes Auditorium, Boston, MA. This show will feature more than 200 displays and booths of Apple-compatible products and accessories. Seminars and panel discussions will be held. Ticket prices are \$6 per day or \$15 for a three-day pass. Contact National Computer Shows, 824 Boylston St., Chestnut Hill, MA 02167, (617) 739-2000.

*May 15-16*

**The North American Computer Othello Championship**, Learning Resources Center, Andersen Hall, Northwestern University, Evanston, IL. This two-day tournament is sponsored by the United States Othello Association. Champions will be determined in three categories: microcomputer systems (located on site), mainframe systems (telephone hookup), and special-purpose Othello machines. For complete tournament details, write to Professor Peter W. Frey, Dept. of Psychology, Northwestern University, Evanston, IL 60201.

*May 18-20*

**Microcomputers—A New Tool for Foresters**, Purdue University, West Lafayette, IN. Sponsored by Purdue University's Department of Forestry and Natural Resources and by the Inventory and Systems Analysis Working Groups of the Society of American Foresters, this conference seeks to advance the professional forester's knowl-

edge of microcomputers and to introduce currently available microcomputer applications in forestry. Session themes include hardware and software considerations as well as information-processing and forest-inventory systems. Contact John W. Moser Jr., Dept. of Forestry and Natural Resources, Purdue University, West Lafayette, IN 47907, (317) 494-3596.

*May 19-21*

**Computer Hong Kong 82**, Regent Hotel, Hong Kong. This three-day program, which embraces the Fifth Hong Kong Computer Conference, will focus on the electronic data-processing market. For further details, contact Kallman Associates, 5 Maple Court, Ridgewood, NJ 07450, (201) 652-7070.

*May 21-23*

**The 1982 Computer Showcase Expo**, Boston, MA. For details, see March 26-28. ■

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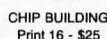
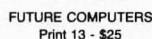
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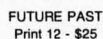
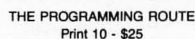
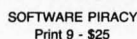
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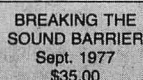
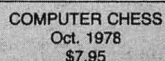
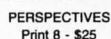
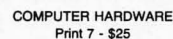
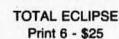
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# The Computer Toolbox

Mark Bernstein  
Department of Chemistry  
Harvard University  
12 Oxford St.  
Cambridge, MA 02138

Scientists everywhere are learning to detest small computers. They hate the things with a special passion reserved for anything that interferes with their research. Although researchers were among the first to embrace the promise of small, inexpensive computers, many now avoid using microcomputers in their labs.

It oughtn't to be so. Scientists *need* computers to monitor, coordinate, and control their experiments. Communicating rapidly and reliably with many different instruments, a computer can read and record data while responding swiftly to any problems that develop. The computer cannot grow bored or tired, nor will it object to uncomfortable or dangerous working conditions.

Above all, experimenters need the flexibility and adaptability that computers promise. Labs are exciting, disorganized, chaotic places. Cables run everywhere to connect instruments piled on tables and stacked on the floor. New equipment and new procedures are commonplace; ideas and plans are in continual flux. Even when everything works perfectly, the results of a few hours' work may call for a complete redesign of the entire experiment.

The modern microcomputer is easy and inexpensive to reprogram, so it *ought* to be a superbly flexible lab assistant. But it is this promise that small computers have betrayed. Microcomputers, expected to help scientists manage the constantly changing laboratory environment, implacably oppose every change and trivial modification.

Each change in the experiment calls for new software. Each new instrument needs new software. Every modification of hardware or tech-

nique demands new software. The computer's constant hunger for new and revised programs may be so daunting that promising experiments aren't even attempted. Laboratory computers have to be intimately involved with many aspects of the experiment, but this intimacy demands that they change and adapt constantly. Unfortunately, common programming techniques often produce programs that are obscure to read and tedious to modify.

## The Computer Toolbox

Rather than design an inflexible computer for a specific job, our research group has tried to build a general-purpose laboratory assistant

that can be carried, like a toolbox, from one experiment to another. It is an integrated, consistent package of hardware and software tools for the experimenter, who should be able to patch together a working system in a few days.

Just as a regular toolbox includes many wrenches and screwdrivers of various sizes, the computer toolbox contains many different "inlets" and "outlets" for information and a collection of interfaces of various sorts. Few experiments use every part in the toolbox; we tried to provide enough interfaces of each type for any experiment we expect to do.

The toolbox includes not only many types of interfaces but also

Device Type	Useful For	Relative Cost	Suggested Quantity and Comments
parallel input port	reading digital devices	inexpensive	many
parallel output port	controlling digital devices	inexpensive	many
keyboard	on/off controls		
video display	input from people	moderate	1
	output to people	expensive	use extra displays for graphics
serial interface			1-5
	interface printers, computers	moderate	
printer	permanent records	expensive	1
plotter	permanent records	expensive	1
telephone interface	report emergencies	moderate	1 if experiment must run unattended
analog-to-digital converter			some
	analog input	inexpensive	
digital-to-analog converter			
	analog output	moderate	some
sound generator			
	alarms and warnings	inexpensive	many distinct noises can be invaluable if required
digitizing tablet			
	input from charts and graphs	expensive	
joystick	input from people	inexpensive	sometimes convenient
stepping motor	moving things	inexpensive	very useful
AC controller	power control	moderate	several
arithmetic processor	arithmetic	expensive	for demanding calculations

Table 1: Widely useful equipment for computer toolboxes.



many interfaces of each different type (see table 1). Redundant facilities add little to the cost or complexity of the toolbox and greatly enhance its usefulness. Because several interfaces of each type are available, adding new apparatus to an experiment is easy. Scientists will not be forced to choose between one instrument and another, because they are free to connect lots of instruments at once.

If an interface circuit is accidentally damaged, redundant interfaces allow work to continue. The computer need not be repaired immediately, and the damaged interface can be fixed at the scientist's convenience. Redundancy makes the system robust, despite the hazards of the laboratory environment.

### Software Design in the Lab

Most laboratory programs live only a few weeks or months. Indeed, many programs are modified so often that they are really never "finished." To make matters worse, laboratory software is written by scientists, i.e., by ingenious, amateur, and relatively unschooled programmers. The lab computer must emphatically encourage clean, comprehensible, modifiable programming.

Lab programmers face a diverse and confusing array of complicated devices, each posing distinct programming problems. Although the procedures for each instrument may be simple, the entire repertoire of communications methods for a complete experimental setup can easily baffle and dismay the programmer. Programs degenerate to an ill-structured network of procedure calls, timing loops, and code conversions, as a profusion of detail overwhelms the program's overall design.

Debugging these tangled, baroque routines is terribly frustrating. The toolbox restores clarity and explicitness to program structure by treating all devices on an equal footing. Toolbox programs never talk directly with any outside instrument. Instead, they communicate with small programs called *device drivers* that, in turn, communicate with the experiment's instruments and sensors.

Device drivers make programs

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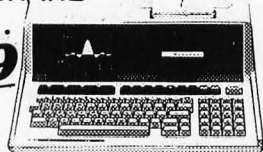
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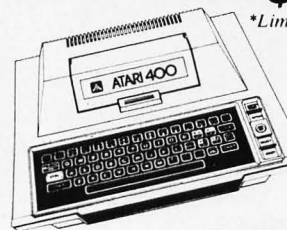
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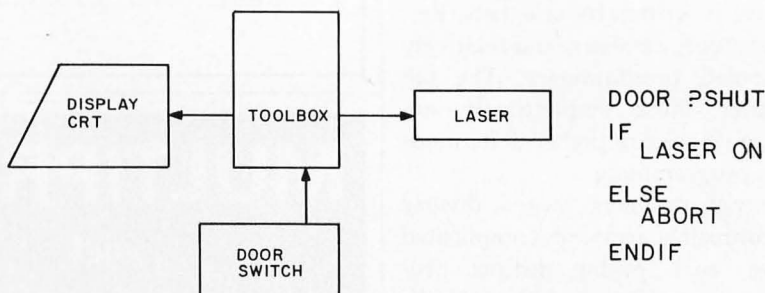
easier to understand and modify. Programmers can concentrate on the experiment without undue distraction from the computer's idiosyncrasies. Device drivers clarify program structure, since irrelevant details need not be represented explicitly. Programs are easier to understand, use, and revise. Documentation is easier to write, and its completeness is less crucial.

Communications between the programmer and the various device drivers are simple and standardized; all device drivers "look" pretty much the same. The device driver, in turn, understands and accommodates the special requirements of each device or instrument. Device drivers shield and protect the toolbox programmer from his confusing and ill-behaved array of instruments (see figures 1 and 2).

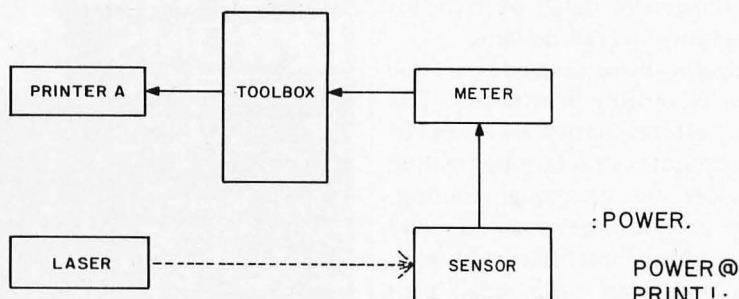
For example, different printers may require different character codes, signal levels, and control signals. None-

theless, all printers are logically equivalent—they all accept characters from a computer and print them on paper. A toolbox program that uses a printer need not consider the details of the printer's interface or timing. Whenever a number must be printed, the program invokes the device driver { PRINT! }. If I replace the printer with a different model, I just revise { PRINT! }. All my programs will still work. If, on the other hand, every program communicated directly with the printer, I would have to modify every program. Indeed, I might need to modify every printer command in every program!

Device drivers help adapt the computer to the changing needs of its peripherals. To plot results on a chart recorder instead of printing them, for example, we need to make only slight changes. Chart recorders are logically equivalent to printers; they just accept numbers from the computer and



**Figure 1:** Many scientists defeat the safety interlocks on their equipment because they simply get in the way too often. Simple additions to toolbox programs can help restore protection. Here, a few words prevent the laser from firing if the door is open.



**Figure 2:** This short program reads the laser's power and prints it. If I buy a new printer, I simply redefine { PRINT! } to work with the new machine. The old program still works with the new printer.



put them onto paper. So, to use the chart recorder we simply replace { PRINT } with { PLOT } and, instead of printing a list of numbers, the computer will draw a graph of the experiment's results.

Device drivers can exchange data with instruments, other toolboxes, even with other computers. In fact, the (still hypothetical) device driver { TELEPHONE! } could connect an experiment to thousands of printers and computers throughout the world.

Programmers don't need to know all the details of every device's design and operation. Of course, the author of the device driver must understand these details, but, since device drivers are all used in pretty much the same way, anyone else can use the device driver.

Tables 2 and 3 describe several device drivers. Drivers that send a single number or character to an instrument have names that end in an exclamation point (!), like { PRINT! }. Drivers that receive a single number or character have names followed by an at sign (@). Device drivers that receive data from an instrument and display it immediately have names ending in a question mark (?), while device drivers that test an instrument's status, and that abort if an error has been detected, have names that begin with a question mark.

In fact, knowing the name of the device driver is often all that a programmer needs to know to use an instrument.

### The FORTH Language

Many computer languages might be suitable for use in the toolbox. The language chosen must be implemented efficiently, especially because small computers tend to be slow and their memory space is often restricted. Invocation, the ability to execute a subprogram by naming it, is required for implementing the device drivers. Other features are convenient, but efficiency and invocation are not expendable.

These considerations exclude the two methods most commonly used to program small computers. BASIC does not support invocation, except

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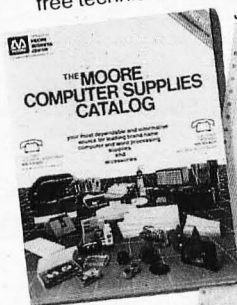
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in a most primitive and unsatisfac-  
tory manner. Common BASIC inter-  
preters, moreover, are too slow for  
many laboratory situations. Assem-  
bly language does not intrinsically  
support invocation either, although  
macroassemblers (which support in-

vocation quite satisfactorily) are now  
available for many machines. Unfor-  
tunately, extensive use of macro-  
instructions only exacerbates the  
propensity of assembly language to  
produce very long programs. Few  
microcomputer assemblers can com-

Device Type	Quantity	Total Channels
parallel port	6	96 data bits 12 control signals
serial port	1	1 (300 bps)
AC power control	4	4 100-W channels
ADC	1	2 bipolar inputs 2 voltage inputs 4 resistor inputs 8 unbuffered inputs
DAC	2	2
IEEE-488 control bus	1	15
sound generator	1	1
graphics display	1	1
scratchpad memory	1	128 bytes
plotter	1	1 (uses DACs)
motor controller	1	1

Table 2: The hardware complement of the author's computer toolbox.

	Driver	Device	Purpose
Data- Transmitting Drivers	!	memory	stores number in specified location in memory
	PRINT!	printer	sends number to printer
	EMIT!	printer	sends character to printer
	DAC!	DAC	sends number to digital-to-analog converter
	VID!	TV camera	sends instruction to camera
	PLOT!	plotter	moves pen to specified coordinate
Data- Receiving Drivers	@	memory	retrieves number from specified location in memory
	THUMB@	thumbwheel	retrieves current thumbwheel setting
	VID@	memory	retrieves current TV camera programming in- structions
	ADC@	ADC	requests measurement from analog-to-digital converter
	POINT@	digitizer	requests one coordinate-pair from the digitizer
IEEE-488 Bus Device Drivers	TALK	IEEE bus	transmits "talk" to an instrument
	UNTALK	IEEE bus	transmits "untalk"
	LISTEN	IEEE bus	transmits "listen" to an instrument
	UNLISTEN	IEEE bus	transmits "unlisten"
	IEEE@	IEEE bus	receives data byte from bus
	IEEE!	IEEE bus	transmits data byte over bus
Special Device Drivers	R/W	disk	reads and writes disk files
	CMOVE	memory	moves blocks of data in memory
	EDIT	disk/screen	creates and modifies disk files
	HOME	screen	returns cursor to top of screen
	FORWARD	motor	advances stepping motor
	ON	AC control	supplies power to outlet
	OFF	AC control	disconnects outlet
	TIME!	clock	sets the clock
	TIME@	clock	reads the clock

Table 3: Some typical device drivers, based on the author's system.



fortably develop programs comprising over a thousand instructions, but experiment controllers often exceed this size.

Several higher-level languages are suitable for programming the toolbox. APL's extraordinary facility for array and matrix calculation easily outweighs its handicaps. Pascal, C, or Ada might also be attractive. Even FORTRAN would be adequate, especially since many scientists already know FORTRAN; this consideration also applies to ALGOL-60 and its descendants.

Unfortunately, currently available microcomputers are rather slow, and thus they demand exceptional efficiency from the toolbox language. Compilers and interpreters for common languages do not now produce sufficiently fast programs and cannot be used. This situation will change as the power and speed of microcomputers improve.

We have used the FORTH language in our toolbox, with very satisfactory results. FORTH has been described in several articles in the August 1980 BYTE, in Ronald Loeliger's *Threaded Interpretive Languages* (BYTE Books, 1981), and in FORTH Inc.'s *Using FORTH*. More advanced but invaluable information is available from FIG (the FORTH Interest Group), which publishes assembly-language implementations of FORTH for many common microprocessors.

The FIG implementation of FORTH is extremely efficient in both space and speed. Although some common programming tasks are difficult to express clearly in FORTH, the language adapts unusually well to laboratory programming. In fact, FORTH was originally designed for just this application. FORTH interpreters are uniquely simple to test and to modify. Several writers report successful implementations of significant subsets of FORTH in only a few weeks. While FORTH is now commercially available for many computers, its easy implementation makes it a practical choice even if a commercial version is not available.

FORTH procedures communicate with each other by using a first-in, last-out stack (see figure 4). Toolbox

routines use the *stack* to exchange information. For example, the routine ADC@ measures the input to the analog-to-digital converter, leaving the result on the stack. DAC! sends the number on top of the stack to the digital-to-analog converter, which produces a corresponding voltage.

ADC@ can talk to DAC! by using the stack; the program

```
ADC@ DAC!
```

reads a voltage at the analog input and transmits it to the analog output. Other programs transform data on the stack, accepting information from one routine, transforming it, and leaving the results for another routine. LOG, for instance, takes a number off the stack, calculates its logarithm, and leaves the result on the stack. The sequence

```
ADC@ LOG DAC!
```

sets the output voltage to the logarithm of the input signal.

In FORTH, numbers are simply procedures that put their value onto the stack. "273" is the name of a procedure that leaves the value 273 on top of the stack. FORTH can work in any common base; the procedure HEX instructs FORTH to treat numbers as hexadecimal quantities, DECIMAL tells FORTH to use base ten, and BINARY makes FORTH use base two.

### Building Toolbox Commands

A scientist controls an experiment by typing commands into the toolbox. Consider, for example, the simple problem of turning equipment on and off during the course of an experiment.

In Harvard's picosecond laser facility, toolbox hardware includes four 117-V AC outlets controlled by the computer. An experimenter might plug an oscilloscope into socket number 1, a meter into outlet 2, a signal generator into outlet 3, and a laser into outlet 4. At various times during the experiment, the computer must supply and remove power to these devices.

The device drivers for the AC

power controller are named ON and OFF. ON and OFF connect and disconnect power to a specified outlet; the command

```
1 ON
```

supplies power to socket number one.

For flexibility and convenience, we might define a new command called SCOPE:

```
: SCOPE 1 ;
```

Whenever SCOPE is invoked, it leaves the value 1 (the scope's socket number) on the stack, so the command

### A Note About FORTH

FORTH uses punctuation in some of its words, which makes representing them in text a difficult problem. For example, one FORTH word is ("), which could be taken to mean one of several character combinations. (For your information, the word has three characters and is made from a left parenthesis followed by a double quote mark and a right parenthesis.)

To decrease the chance of confusion while trying not to clutter text unnecessarily, we have used pairs of braces, { }, to isolate the character string within as a FORTH word or phrase. For example, the above word would be written { (") }. Braces have been used only in the following situations:

- when the material being quoted is a phrase of FORTH words (e.g., { 26 LOAD } or { 35 + })
- with the FORTH words { . } (period), { , } (comma), { : } (colon), { ; } (semicolon), { ? } (question mark), { ! } (exclamation point), { ' } (single quote mark), and { " } (double quote mark)
- with any word using the above punctuation marks (e.g., { \$ . } or { " . " }).

All other FORTH words are set apart by a space on either side of the word. So, in this article, braces always signal a FORTH word or phrase. The braces are not part of the word or phrase, and FORTH words never use braces within the body of a figure or listing. . . . GW



## SCOPE ON

energizes the oscilloscope. If we decide to plug the oscilloscope into some other socket, we simply change the definition of SCOPE. This "informs" all our programs of the change, so we don't have to hunt through every procedure, looking for references to socket number 1.

Commands can be issued singly or in a large burst. Several commands can be put on one line, or a single command can spread over many lines. Extra spaces, carriage returns, and tabs are harmless and make program listings more attractive and easier to follow. Part of an experimental session might read:

```
METER ON    SCOPE ON
            LASER ON
            5 MINUTES
            LASER OFF
```

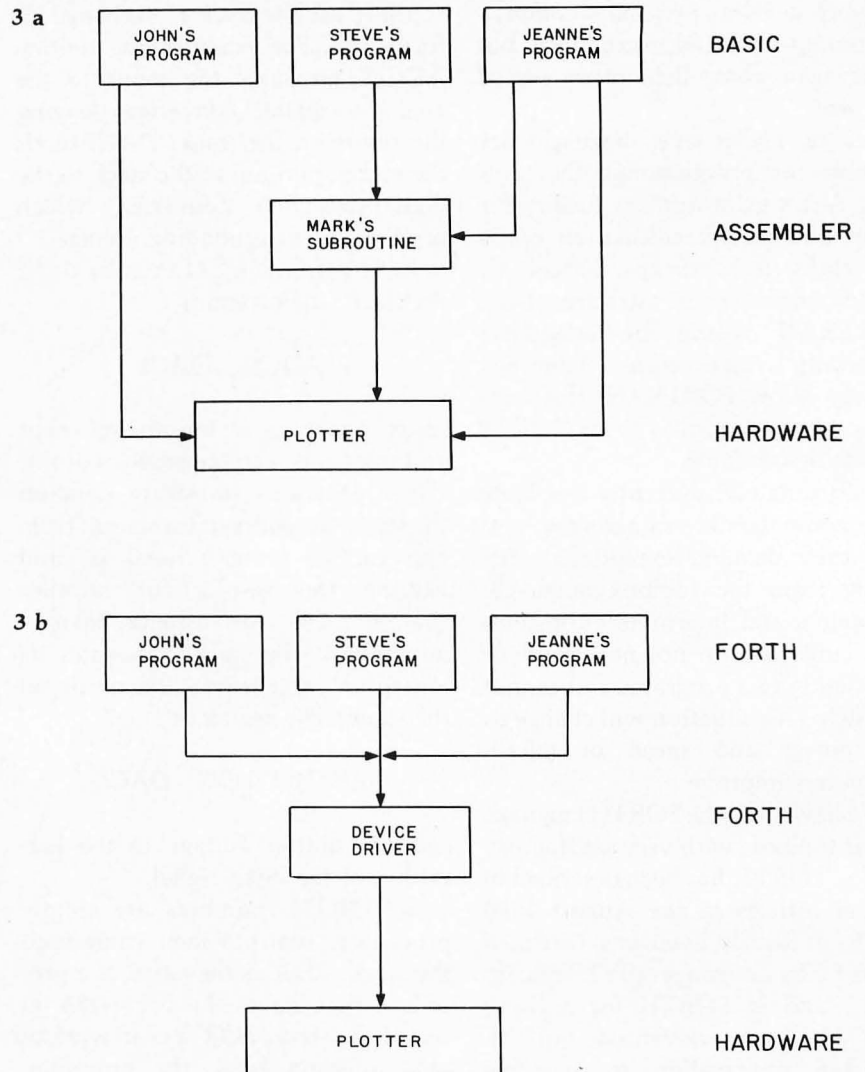
This set of commands turns on the meter, oscilloscope, and laser, waits for five minutes, and then turns off the laser.

If I need to perform this sequence often, it is simple and convenient to group these commands into a single command:

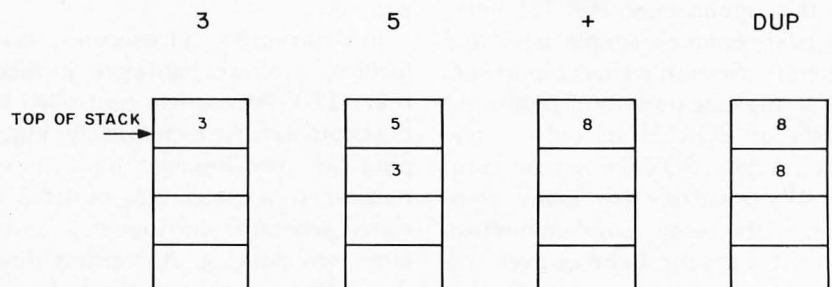
```
: TEST
METER ON SCOPE ON
LASER ON 5 MINUTES
LASER OFF ;
```

Typing TEST tells the computer to perform the entire sequence. This particular sequence might be used to check whether all the instruments are working, and procedures called ALIGN, COLLECT-DATA, and SHUT-DOWN could be used for other parts of the experiment. In fact, TEST can be included as a part of another procedure.

Toolbox commands are easy to create. New commands cost only a few bytes of memory. Powerful and subtle commands can be built up from simpler ones. The toolbox actually encourages programmers to write convenient and comprehensible programs. Toolbox programs that are easy to write and modify are in-



**Figure 3:** In conventional environments, replacing one hardware device can require many software changes. If the plotter is replaced, many programs must be altered. In figure 3a, John and Jeanne must rewrite parts of their programs, and Mark has to rewrite the assembly-language subroutine Steve and Jeanne both use. If Mark leaves for a new job, Steve and Jeanne may be in serious trouble! As shown in figure 3b, the toolbox insulates users from software changes. If the plotter is replaced, the device driver has to be rewritten, but user programs don't need to be changed.



**Figure 4:** Reverse Polish notation and the computation stack. Reverse Polish makes arithmetic look strange but can be perfectly natural for controlling machines.



herently easy to use; man-machine dialogue is intrinsic in the program's structure, not tacked on as an after-thought.

### Amenities

Scientists work in a number-filled world. Contrary to popular myth, though, most scientists have no special facility for arithmetic. In one Cambridge poker game, the regular players include three chemists, a physicist, a stock broker, and a lawyer. To rapidly count and split pots, all defer to the seventh player—an artist.

Since scientists generally can't do arithmetic any better than other people, lab computers should be able to do it for them. When an unexpected question comes up, the lab computer ought to double as a pocket calculator. Our toolbox provides this facility within the FORTH language, because FORTH can do arithmetic very much like any reverse-Polish calculator.

For example, to add 3 to 7 and print the result, we can simply type

3 7 + .

to which FORTH responds

10 OK

{ . } is the FORTH command to display the top value from the stack. FORTH's ability to use any common base is often very useful; to translate, say, hexadecimal 4AF to base ten, we simply type

HEX 4AF DECIMAL .

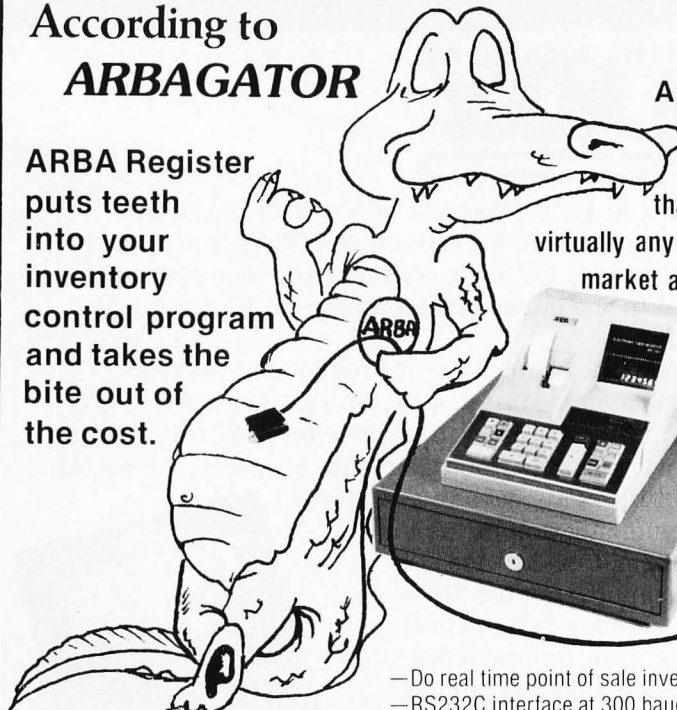
Clocks and timers are often useful. The command SECONDS instructs the toolbox computer to pause for a specified period. The time-of-day clock may be used (through its device drivers) to ascertain or set the current time. For example,

5 47 TIME!

sets the clock to 5:47. The command TIME@ reads the time, leaving the

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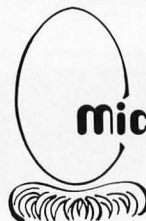
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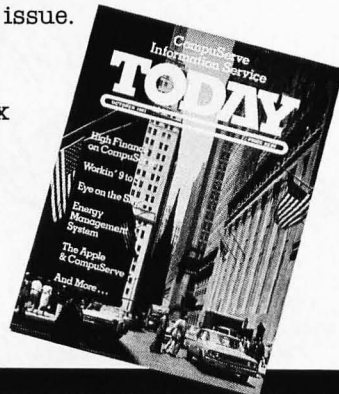
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current time on the stack. CLOCK? prints the time on the TV screen, using an attractive format. Special functions are easy to add; for example, CAL-TIME might print the time in California.

Interestingly enough, our toolbox "clock" is actually a small machine-language program. The device drivers for the clock are "driving" a completely mythical device! In practice, the clock's device drivers manipulate a few bytes of memory in which the clock program leaves the current time, but the user is free to believe that the clock is a hardware device inside the toolbox!

Someday we might just install an integrated circuit to replace the "clock" routine. To do that, we'd simply rewrite the device drivers. If a user did not notice the new integrated circuit inside the computer, he might never know about the new clock circuit.

### The Toolbox Development System

The toolbox approach lets scientists apply computers to laboratory problems that tend to resist conventional design and programming methods. Moreover, developments in computer technology will substantially augment the potential of the toolbox in the next few years. Trends in microprocessor architecture favor designs that emphasize the toolbox virtues of modularity and invocation. A microprocessor designed specifically for efficient FORTH implementation, for example, is now under development. The toolbox relies heavily on its abundant input and output devices, and these, too, are subject to constant improvement.

Computer toolboxes are also uniquely suited to incorporate new advances in integrated-circuit technology. New parts can be plugged into the toolbox, often simply by connecting their pins to the appropriate signals on the system bus. New device drivers are easy to write and can use all the existing toolbox facilities.

For example, our toolbox currently includes programs to calculate logarithms. This job could be performed more effectively by an integrated-circuit arithmetic processor. Physically

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installing such a device would require only a few additional integrated circuits. To install the processor in the toolbox *software*, we would write device-driver programs to control the math processor's operations. These programs could be written on the toolbox, using the existing toolbox software, and tested by comparing the results of the new and old logarithm routines.

Once a new device has been tested, existing toolbox programs may be modified to take advantage of the toolbox's new capabilities. This unusual flexibility suggests that the toolbox, designed to apply small computers to the scientific laboratory, may be a useful tool for developing computer systems! The toolbox makes no distinction between devices that happen to be inside or outside its box; everything is handled by device drivers. The toolbox, designed specifically to control many external devices, can also configure and control its own internal structure.

The toolbox may, like a snake, shed its skin of peripheral controllers, using them in the end only to create and test a new set of more powerful devices. If a better terminal becomes available, the old terminal can be used to write the new terminal's device drivers. An instrument designed this way could design and test its own successor—in fact, the new model could retain many of the old machine's parts and programs!

The toolbox is easy to customize and simple to modify. It can revise its own language and extend its vocabulary to meet the requirements of its user. It can be connected to many devices and can help test new interfaces and new instruments. In short, the toolbox is a very *personal* computer. ■

#### Acknowledgments

*I'd like to express my gratitude and appreciation to Professor Kevin S. Peters, who patiently supported this work, and to the Merck Corporation for the honor of a Merck Corporation Foundation Fellowship.*



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# Skip Sequential: A New File Structure for Microcomputers

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I still remember that fall day almost three years ago at Ecosoft, when we got our first floppy-disk drive up and running. Compared to the cassette system we had been using, it was the greatest thing since fire. It was at that point we began to think that the use of a microcomputer in serious business and research applications was a viable concept. It wasn't much longer before we were sure of it.

Like most disk systems, ours supported both random-access and sequential file structures. Depending upon the intended function, each has certain advantages and disadvantages. Sequential files use disk space very efficiently (an important consideration even with the increased storage capacity of double-density drives), but they are progressively slower on disk accesses as the file size grows. Random-access files are much faster on disk access, regardless of file size, but they require a fixed record length set to the maximum anticipated (i.e., "worst case") size. This often results in a considerable amount of wasted disk space.

The purpose of this article is to discuss a "new" file structure that we developed to help overcome some of the disadvantages associated with random-access and sequential files. The new file structure, which we have named Skip Sequential, is based on such a simple idea that many computerists will wonder why they didn't think of it. It is easy to use, adds little programming overhead, and offers significant advantages over conventional file structures. Although the

text discusses Skip Sequential and its use in terms of North Star BASIC, we have also included listings for Microsoft's BASIC-80. Those familiar with BASIC-80 should have little difficulty implementing Skip Sequential.

## Sequential and Random-Access Files

Before discussing Skip Sequential, it's important to understand the differences between random-access and

---

### **We needed to overcome some of the disadvantages associated with random-access and sequential files.**

---

sequential files. For purposes of illustration, let's assume that you need a program that will store: (1) the customer's name; (2) the amount paid for an item; (3) the date of the purchase; (4) the invoice number of the sale; and (5) a flag variable to reflect whether or not the invoice has been paid. Let's assume that the variables are:

D = Date Sold  
N = Invoice Number  
A = Amount of the Sale  
N\$ = Customer's Name  
F = "Paid" flag  
(F=1 is "Not Paid")

This data could be easily stored using

either sequential or random-access files. Let's examine these two possibilities.

## An Example Using Sequential Files

The program in listing 1 is an example of storing data with sequential files. It is assumed that the values of the variables were determined elsewhere in the program. (If these were actual subroutines, the END statements would be RETURNS.) Line 230 opens the file to be read, while line 240 looks for an end-of-file mark using the TYP command. In North Star BASIC, a unique type will be associated with the data: if it is a string variable, TYP returns a value of 1; if it is a numeric variable, TYP will equal 2; and, if it is an end-of-file mark, TYP returns with a 0. If line 240 finds that TYP is not equal to 0, it falls through to line 250 and reads the data in the file into a set of dummy variables. (Dummy variables must be used so that we don't destroy the new data that we want to add to the file.) Once the end-of-file is found, the branch in line 240 is executed and we write the new data to the file (line 270).

Note that as new transactions are entered, more and more time is spent in the loop formed by lines 240 through 260 looking for the end-of-file mark. Because sequential files require that the entire data file be read before any new data can be written, the time lost looking for the end-of-file is a major limitation of sequential files. On the other hand, a sequential file is a "dense" file (i.e., there are no



wasted gaps in the file). Each new piece of data is tightly packed against the previous piece of data, so disk space is used very efficiently. However, the programmer must decide between optimal use of disk space or faster operation: a choice that usually dictates use of random-access files.

### An Example Using Random-Access Files

Listing 2 presents the same type of program as that shown in listing 1, but using random-access files. A major difference between the two programs is that random-access files must use a fixed record length (i.e., each transaction will use exactly the same number of bytes in all instances). The programmer must decide this length, and in making that determination needs to know the following: how many bytes are required to store a numeric variable; how many bytes should be allocated to store string data (including any "overhead" bytes associated with such string variables); and how many numeric and string variables will be used in each record. In our example, we use four numeric variables (D, N, A, and F) and one string variable (N\$).

The first task is to determine how many bytes are needed for each floating-point number stored in the numeric variables. For North Star BASIC, this can be determined by the following equation:

$$B = (P/2) + 1$$

where:

B = the number of bytes in a floating-point number

P = the precision of the BASIC

For the standard version of North Star BASIC (8-digit precision BASIC), each floating-point number requires 5 bytes.

To determine the requirements for the name field, the programmer must decide on a string length that will be long enough to hold most customer names, but not so long as to waste

**Listing 1:** This routine, written in North Star BASIC, adds a record to the end of an existing sequential file.

```

100 REM=====
110 REM      This is an example of a sequential file for North Star DOS
120 REM      and Basic
130 REM
140 REM      10-15-80
150 REM      Purdum
160 REM      Ecosoft
170 REM=====
180 REM
190 REM      This program is treated as a subroutine where the values of the
200 REM      variables are determined before entering it.
210 REM
220 REM
230 OPEN #0,"BYTE"\REM      Activate file
240 IF TYP(0)=0 THEN 270
250 READ #0,D1,N1,A1,N1$,F\REM      Read dummies if data present
260 GOTO 240
270 WRITE #0,D,N,A,N$,F\REM      Found E.O.F.,write new values
280 CLOSE #0
290 !"END"\END

```

**Listing 2:** This routine adds a new record to a random-access file. The number of records in this file is stored at the beginning of the file and updated after each write operation.

```

100 REM=====
110 REM      This is an example of a random access file for North Star
120 REM      DOS and Basic
130 REM
140 REM
150 REM      10-15-80
160 REM      Purdum
170 REM      Ecosoft
180 REM=====
190 REM      This program is also treated as a subroutine where the values
200 REM      of the variables are determined before entering it
210 REM
220 REM
230 OPEN #0,"BYTE"
240 READ #0,R\REM      R contains # of records on disk
250 WRITE #0,(52*R+5),D,N,A,N$,F      Update record count
260 R=R+1\REM
270 WRITE #0,0,R,NOENDMARK
280 CLOSE #0
290 END

```

Variable	Type	Bytes	Overhead
D	Numeric	5	-0-
N	Numeric	5	-0-
A	Numeric	5	-0-
N\$	String	30	2
F	Numeric	5	-0-
Totals:		50	2
Record Length:		52	

**Table 1:** To calculate the fixed record length for a random-access file, simply sum the number of bytes required by each variable (or field) within a record.

unnecessary disk space. In our example, we selected 30 bytes for the name string (N\$). It should be noted that North Star BASIC requires 2 overhead (or *housekeeping*) bytes for each string that is less than 255 bytes long (3 bytes are required if the string is longer than 255 bytes). We can now determine the fixed record length for the random-access file, as shown in table 1.

Having determined the fixed record length, the programmer can proceed to write the program (see the example shown in listing 2). We have assumed that the programmer has written a 0 (zero) to the file for R (the variable that informs the program of how many previous transactions have been written to the disk). Since R is a floating-point number, the file has 5 bytes in it before it is even used. The



percent sign (%) in line 250 of listing 2 is interpreted to mean "jump the following number of bytes" and write the new record. If this is the first entry, the program will jump over  $0 \times 52$  bytes, plus 5 more bytes. Since  $0 \times 52$  is 0, the program jumps over 5 bytes (jumps over the R variable) and writes the new data. Line 260 increments the record count in R and writes the new value of R at the beginning of the file (the %0 says to jump over 0 bytes, hence rewriting R). The NOENDMARK command informs the interpreter not to write an end-of-file mark after updating R. If the end-of-file mark was written after R, the program would think that the file ended after the first 5 bytes.

The advantage of random-access files is that we don't have to read through the entire file to perform a write operation. By simply reading R and jumping the correct number of bytes (lines 240 and 250 in listings 2), we know exactly where the new data should be written. There is a price to pay for the increased speed, however. If a customer's name is "W. Oz", which is only 5 bytes long including the blank, we must still allocate 30 bytes because of the fixed record requirement of random-access files. We have wasted almost 50% of the record space, a circumstance that is of particular importance when working with the smaller capacities of 5-inch floppy disks. Even the end user might get a little cranky if he knew that half of his disk space was going to waste.

### Skip Sequential: The Best of Both Worlds

The main advantage of a Skip Sequential file is that it has the same speed as a random-access file, but does *not* require the use of fixed record lengths. This means that it can write data to the disk with the same speed as random access, but does so without wasting disk space. If a customer's name is 5 bytes long, it will use only 5 bytes. We've been using Skip Sequential for almost three years and have virtually eliminated sequential files from our programming choices. In all but the most trivial cases, Skip Sequential beats sequential files, hands down.

**Listing 3:** *Initializing a Skip Sequential file requires that a single number be written to the file. Since this number will serve as the file byte counter, and is itself 5 bytes long, it is set to 5 on initialization.*

```

100 REM=====
110 REM      Initialization routine for Skip Sequential prior to use
130 REM
140 REM
150 REM      10-15-80
160 REM      Purdum
170 REM      Ecosoft
180 REM=====
190 REM      This program write a single number to a SS data file, the value
200 REM      of which is equal to the number of bytes/floating point number.
210 REM
220 REM
230 OPEN #0,"BYTE"
240 X=5\REM
250 WRITE #0,X
260 CLOSE #0
270 END

```

We're assuming 8-digit precision

Skip Sequential is easy to use and requires little programming overhead. Essentially, it is a random-access file with a fixed record length of 1 byte: all we have to do is keep track of the number of bytes already written to the file. To this end we must provide a byte counter when the file is initialized (before using Skip Sequential). The program in listing 3 illustrates this process.

When preparing a file for Skip Sequential, you must first write a single number to the file. The value of that number depends upon the number of bytes required for a floating-point number. North Star BASIC, for example, uses 5 bytes for such numbers, so X in line 240 of listing 3 is set to 5. Line 250 writes the number 5 to the file, and the program ends. Why do we have to write this number? Since we must keep track of the number of bytes written to the file, and the counter is a number which is 5 bytes long, 5 bytes are written to the file when we write the byte counter in line 250. The program in listing 3 has done what it's supposed to do: keep track of the number of bytes in the file—exactly 5. Having initialized the byte counter, we are now ready to use the file.

The program in listing 4 can be used to implement the sample program discussed earlier. Line 240 reads the byte counter, while line 260 says to "skip over" B bytes and then write the new data to the disk. The first time through, B will equal 5 bytes, since only the byte counter is in the file. Note that North Star BASIC "skips" with respect to the beginning

of the data file; some operating systems may do this with respect to the disk head after reading B. If this is true, the byte counter must be initialized to 0 in listing 3. Once the skip is performed in line 260, the new data is written to the disk in the conventional manner.

Disk space is saved through line 270, which sets L equal to the length of N\$. Line 280 increases the byte counter to reflect the number of bytes written to the disk. Since there are four numbers of 5 bytes each, this is added to B, plus the length of the string, L, plus the 2 overhead bytes associated with each string. If the name were "W. Oz", L would equal 5, and the total number of additional bytes would be 27. The byte counter would reflect 32, the total number of bytes in the file (27 new bytes plus 5 for the byte counter itself). Line 300 then writes the new value of the byte counter to the beginning of the file.

Note what happens in listing 4 when a second entry is made to the file. Line 240 returns with 32 in B. The program then skips over 32 bytes in line 260 and writes the new transaction in the proper place in the file. The disk-write operation is actually performed faster than the random-access example given earlier, since B does not have to be calculated. Fixed record lengths are not used, so we save the difference between the actual string length and the worst case string length that would have been used with random-access files. As the file grows longer, the savings can be substantial.

It is quite simple to read the file



**Listing 4:** New records may be added to a Skip Sequential file with this routine. The length of each record varies with the length of N\$, the string variable containing a customer name.

```

100 REM=====
110 REM  This is an example of a Skip Sequential file for North Star
120 REM                      DOS and Basic
130 REM
140 REM
150 REM                      10-15-80
160 REM                      Purdum
170 REM                      Ecosoft
180 REM=====
190 REM  This program is also treated as a subroutine where the values
200 REM    of the variables are determined before entering it
210 REM
220 REM
230 OPEN #0,"BYTE"
240 READ #0,B\REM          B contains # of BYTES written to disk
250 REM
260 WRITE #0%B,D,N,A,N$,F\REM  Skip over the bytes already on disk
270 L=LEN(N$)
280 B=B+(5*4)+L+2\REM        Up B by number of new bytes written
290 REM
300 WRITE #0%0,B,NOENDMARK\REM  Now update byte counter
310 CLOSE #0
320 END

```

**Listing 5:** Each record of a Skip Sequential file is read by calculating the individual record lengths as they are read and adding this value to the current byte count.

```

100 REM=====
110 REM  This program reads a Skip Sequential file using North Star DOS
120 REM                      and Basic
130 REM
140 REM
150 REM                      10-15-80
160 REM                      Purdum
170 REM                      Ecosoft
180 REM=====
190 REM
200 REM
210 REM
220 DIM N$(30)
230 E=5\REM                Must set a variable, E, equal to the number
240 REM                      of bytes per floating point number.
250 OPEN #0,"BYTE"
260 READ #0,B
270 READ #0,D,N,A,N$,F
280 !D,TAB(10),N,TAB(20),A,TAB(30),N$,TAB(65),F
290 L=LEN(N$)
300 E=E+(5*4)+L+2
310 IF E<B THEN 270
320 !\!"END OF LISTING"
330 CLOSE #0
340 END

```

using sequential techniques. An example is given in listing 5. Note that E is equal to 5 in line 230. By using this variable in the same manner as B in listing 4, a comparison of E and B (as in line 310) is equivalent to testing for an end-of-file mark. Since E is updated in line 300, we know that we have read all of the data in the file when E is equal to B.

The program in listing 5 does point out one potential problem. In those cases where N\$ might be empty, line 270 expects to see an N\$ in the file. The simplest way to avoid a type error on a read operation is to set N\$ equal to one blank before writing it to the disk in listing 4. While this does waste 3 bytes, the loss is trivial compared to the other savings of the Skip Sequential method.

### Updating a Skip Sequential File

Another advantage of Skip Sequential over sequential files is that they can be updated almost as easily as random files. Suppose that we want to use the flag variable (F) to reflect whether or not the transaction is paid. Assuming the F equaled 1 when the transaction was originally written, we now want to update it to a paid status. We will further assume that the new value of F will reflect the date it was paid (although it could be a check number or any other numeric data). Listing 6 contains an example of updating a Skip Sequential file.

Line 250 again sets the end-of-file counter, E. Lines 270 through 310 read the data and update E. Line 330 asks if this is the proper invoice number. If it isn't, line 350 is executed: this tests

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**Listing 6:** In order to update a Skip Sequential file, each record must be searched until the proper one is located. A new value of the same length must then be written into that record.

```

100 REM=====
110 REM This program updates a variable in a Skip Sequential files using
120 REM North Star DOS and Basic
130 REM
140 REM
150 REM 10-15-80
160 REM Purdum
170 REM Ecosoft
180 REM=====
190 REM This program assumes we want to set the flag variable, F, to
200 REM equal the current date, which is held in variable Y. The trans-
210 REM action to be updated has an invoice number that must match N1.
220 REM
230 REM
240 DIM N$(30)
250 E=5\REM Must set a variable, E, equal to the number
260 REM of bytes per floating point number.
270 OPEN #0,"BYTE"
280 READ #0,B
290 READ #0,D,N,A,N$,F
300 L=LEN(N$)
310 E=E+(5*4)+L+2\REM Update number of bytes read, variable E
320 REM
330 IF N=N1 THEN 430\REM Is it the one we're looking for?
340 REM
350 IF E<B THEN 290\REM Compare to B to see if we've read all bytes
360 I\!"CANNOT FIND A MATCH FOR INVOICE NUMBER",N
370 CLOSE #0
380 END
390 REM ***** Update Flag *****
400 REM Since F is the last variable read and E con-
410 REM tains the number of bytes read, back up 5
420 REM bytes and write the date paid.
430 WRITE #0%(E-5),Y,NOENDMARK
440 CLOSE #0
450 I\!"INVOICE MARKED 'PAID' WITH TODAY'S DATE.",\!
460 END

```

**Listing 7:** Microsoft BASIC-80 version of the initialization routine for a Skip Sequential file.

```

100 REM=====
110 REM Skip Sequential files for Digital Research's CP/M operating system and
120 REM Microsoft's Basic-80.
130 REM
140 REM 10-15-80
150 REM Purdum, ECOSOFT
160 REM=====
170 REM
180 REM The function of this program is to initialize the data file
190 REM called BYTE for use as a Skip Sequential data file. It assumes
200 REM double-precision numbers are used in the data file.
210 REM
220 OPEN "R",#1,"BYTE",8:REM A random file with a fixed record
230 REM length of 8 bytes.
240 FIELD #1,8 AS Y$
250 M=1:REM One record will be in it
260 LSET Y$=MKD$(M)
270 PUT #1,1:CLOSE #1:END

```

for an end-of-file condition. If we haven't read all of the data, we go to 290 and read some more. If the proper match is in 330, control is sent to 430 to write today's date (assumed to be in Y) in place of F. Note how this is accomplished. Upon finding a match in 330, E contains the number of bytes read thus far. Since F is a 5-byte number, we need to back up 5 bytes before writing Y in place of F. For this reason, five is subtracted from the variable E in line 430. The rest of the line writes the date, Y, with no end-of-file mark, to the file. We are, of course, assuming that Y is also a number.

## Skip Sequential for BASIC-80

We have also included a program similar to the above but modified for Microsoft's BASIC-80. The program listings are similar to the North Star BASIC versions, but the differences between interpreters do require some changes.

One of the major differences between North Star BASIC and BASIC-80 is that BASIC-80 requires that record length be given when the file is opened. Listing 7 shows how a Skip Sequential file is initialized using BASIC-80. Since we use dollar amounts as one of the variables in the data file (i.e., A), the programmer will



**Listing 8: BASIC-80 routine to add a record to a Skip Sequential file. Note that this routine uses an 8-byte record length instead of the 1-byte length used in North Star BASIC.**

```

100 REM=====
110 REM      Writing data to a Skip Sequential data file
120 REM      CP/M and Basic-80
130 REM
140 REM      Purdum, Ecosoft
150 REM      10-15-80
160 REM=====
170 REM
180 REM      The function of this program is to write the data to the SS file
190 REM      called BYTE. It assumes values are given upon entering the routine.
200 REM
210 REM
220 IF LEN(N$)=0 THEN N$=SPACE$(8):REM      If no name wanted, write 8 blanks
230 REM
240 REM      Begin file write
250 REM
260 OPEN "R",#1,"BYTE",8:FIELD #1,8 AS Y$
270 REM
280 GET #1,I:U=CVD(Y$):U=INT(U):REM      Get # of records already in file in U
290 U=U+1:REM      Up counter
300 REM
310 LSET Y$=MKD$(D):PUT #1,U:REM      Write a new one, D
320 U=U+1
330 LSET Y$=MKD$(N):PUT #1,U:REM      Another one, N
340 U=U+1
350 LSET Y$=MKD$(A):PUT #1,U:REM      Yet another, A
360 U=U+1
370 REM      *** Now find how many records needed for N$ ***
380 REM
390 IF LEN(N$)/8>INT(LEN(N$)/8) THEN X=INT(LEN(N$)/8)+1 ELSE X=INT(LEN(N$)/8)
400 REM
410 LSET Y$=MKD$(X):PUT #1,U:REM      Save number of records, X
420 REM
430 REM      Now write N$ as 8-byte records
440 FOR J=1 TO X
450   LSET Y$=MID$(N$,8*J-7,8)
460   PUT #1,J+U
470 NEXT J
480 REM
490 U=U+X
500 F=1:REM      Add flag variable, F=1=active
510 U=U+1
520 LSET Y$=MKD$(F):PUT #1,U
530 LSET Y$=MKD$(U):PUT #1,1:REM      Update counter for new records added
540 CLOSE #1
550 END

```

**Listing 9: BASIC-80 program to read data in a Skip Sequential file.**

```

100 REM=====
110 REM      This program reads the Skip Sequential file for CP/M and
120 REM      Basic-80
130 REM
140 REM      10-15-80
150 REM      Purdum, ECOSOFT
160 REM=====
170 REM      This is also treated as if it were a subroutine
180 REM
190 OPEN "R",#1,"BYTE",8:FIELD #1,8 AS Y$
200 GET #1,I:U=CVD(Y$):REM      Get record counter in U
210 REM
220 M=2:REM      We want second record
230 GET #1,M:D=CVD(Y$):REM      Get date
240 M=M+1
250 GET #1,M:N=CVD(Y$):REM      Get Invoice number
260 M=M+1
270 GET #1,M:A=CVD(Y$):REM      Get amount
280 M=M+1
290 GET #1,M:X=CVD(Y$):REM      Get byte-length of customer name in
300 REM      terms of 8-byte records into X
310 FOR J=1 TO X
320   GET #1,M+J:N$=N$+Y$:REM      Stuff name in N$
330 NEXT J
340 M=M+X:REM      Bump read counter for N$ length
350 M=M+1
360 GET #1,M:F=CVD(Y$):REM      Get flag and we're done
370 IF M<>U THEN 200
380 CLOSE #1:END

```

probably want to use double-precision numbers. In BASIC-80, 8 bytes are required for each numeric variable. Lines 220 and 240 inform the interpreter that we will be using a fixed

record length of 8 bytes instead of the 1-byte record in the North Star BASIC version of Skip Sequential (Microsoft BASIC-80 does not allow a record length of 1). Line 260 con-

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verts the value of M into a string for writing to the disk. This is essentially identical to the use of random-access files in North Star BASIC to this point.

Listing 8 illustrates how the data is written to the Skip Sequential file. The only unusual part of the program occurs between lines 390 and 480. Line 390 makes the name held in N\$ an even multiple of 8 bytes. The value of X tells us how many multiples there are, and since we need to know this X value later to read N\$, line 410 saves it in the file as part of the transaction. Lines 440 through 480 save N\$ to the disk as 8-byte records. The remainder of the program is the BASIC-80 equivalent of writing the flag variable and the updated record counter.

Listing 9 is the program to read the Skip Sequential file. The only unusual segment is the reconstruction of N\$ in lines 310 through 330. The updating need not be discussed, since it would be identical to updating any other random file in BASIC-80.

Several improvements could be made to the BASIC-80 version. For

example, X could be "packed" with the date, given the double-precision numbers of BASIC-80 and the fact that X will never exceed four in the sample program. We also think that there may be a way to trick the interpreter into accepting a 1-byte record length instead of 8 bytes, but we haven't experimented sufficiently. Still, Skip Sequential can save disk space over conventional random-access files, albeit the savings aren't quite as great.

### Concluding Thoughts

Skip Sequential files do offer many advantages to the programmer and, indeed, the end user. In general, Skip Sequential files may be used for the following: in almost any application where ordinary sequential files are appropriate; in any situation where data is archival in nature (e.g., data backups, transactions, or historical entries); and where only limited updating is required (e.g., setting flags). As a general rule, Skip Sequential strings cannot be updated unless the new and old string lengths are the

same. For this reason, data sets that require frequent updating, such as mail or customer lists, are better suited to random-access files.

Finally, Skip Sequential files can be used in a way that simulates ISAM (indexed-sequential access method) files. For example, if a separate file holds the byte-counter values that exist for the first entry of each month, those byte-counter values can be read first and used to jump to the first entry of the month in the Skip Sequential file. This will further enhance the speed of data retrieval.

While the documentation for the Skip Sequential method has been copyrighted, and we have applied for a trademark on the name, I encourage you to make use of the files. If you plan to make commercial use of the Skip Sequential method, I'd appreciate it if you would contact us first. ■

### Acknowledgments

*I would like to thank my business associate and friend, Dr. J. B. Orris, for his comments on an earlier draft of this article.*

# FIND OUT WHAT FITS WHAT.

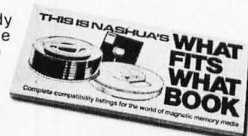
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## Finding Words That Sound Alike

### The Soundex Algorithm

Jacob R. Jacobs  
1903 Fordham Way  
Mountain View, CA 94040

The name I am searching for is "Johnson." But is it spelled "Johnson," "Johnsen," "Jonson," "Jonsen," or "Johanson"? The Soundex algorithm can help find words that sound alike by reducing a string to a Soundex code string consisting of a letter and up to three digits.

Alphabetic strings that sound alike generate identical Soundex code strings. The Soundex system is used in the Whatsit data-management system (from Computer Headware, POB 14694, San Francisco, CA 94114) that runs on the Apple, but the program presented here is my own. In the Whatsit program, you can ask, "WHAT SOUNDS (LIKE) JOHNSON?" Whatsit then lists every word it "knows" that sounds like the word "Johnson."

The Soundex algorithm was recently described by P.A.V. Hall and G.R. Dowling ("Approximate String Matching," *ACM Computing Surveys*, 12, 4, December 1980, p. 388), and it works as follows. We will call the entry-name string E\$ and the reduced output code string R\$. The first character of R\$ is merely the first character of E\$. The remaining letters of the E\$ string are replaced by their group code numbers as shown in table 1. Then all zeros are removed, and consecutive occurrences of the same digit are reduced to a single digit. Finally, the code is truncated on the left to leave one letter and up to three digits.

The Soundex program in listing 1 is written in Applesoft BASIC. To simplify conversion to other BASICs, I will give examples of the Applesoft MID\$ and LEFT\$ functions. A\$=MID\$(B\$,6,4) will set the string variable A\$ to a four-character substring of B\$ starting at the sixth character. A\$=LEFT\$(B\$,2) will set A\$ to the first two (i.e., leftmost) characters of B\$.

The Soundex subroutine beginning at line 1000 of listing 1 will accept the input string E\$ and return the reduced-code string R\$, and it will throw away

nonalphabetic characters. Lines 10 through 40 dimension the arrays E\$ and R\$, which are used for demonstration purposes only. The array W(N) is initialized to the group number corresponding to the Nth letter of the alphabet.

**Listing 1:** *Written in Applesoft BASIC, this program accepts a character string E\$ as input, converts it to the Soundex code string R\$, and prints out all words that have the same code string.*

```
10 J = 0
20 DIM E$(99),R$(99)
30 DIM W(26)
40 FOR I = 1 TO 26: READ W(I): NEXT
50 PRINT : INPUT "INPUT STRING: ";E$: PRINT
60 GOSUB 1000
70 J = J + 1
80 R$(J) = R$
90 E$(J) = E$
100 FOR M = 1 TO J
110 IF R$(M) = R$ THEN PRINT E$(M)
120 NEXT
130 GOTO 50
1000 REM SOUNDEX SUBROUTINE
1010 L = LEN (E$)
1020 S$ = ""
1030 R$ = LEFT$ (E$,1)
1040 ST = 0
1050 IF L < 2 THEN RETURN
1060 FOR I = 2 TO L
1070 C = ASC ( MID$ (E$,I,1))
1080 IF C < 65 OR C > 90 GOTO 1120
1090 C = C - 64
1100 W = W(C)
1110 IF W < > 0 THEN S$ = S$ + CHR$ (W + 48)
1120 NEXT
1130 L = LEN (S$)
1140 IF L = 0 GOTO 1210
1150 FOR I = 1 TO L
1160 C = ASC ( MID$ (S$,I,1))
1170 IF C < > ST THEN R$ = R$ + MID$ (S$,I,1)
1180 ST = C
1190 NEXT
1200 IF LEN (R$) > 4 THEN R$ = LEFT$ (R$,4)
1210 RETURN
1220 DATA 0,1,2,3,0,1,2,0,0,2,2,4,5,5,0,1,2,6,2,3,0,1,0,2,0,2
```



## Programming Quickie

For example, W(3) contains the number 2 corresponding to the assignment of the letter C (i.e., the third letter of the alphabet) to the group 2. This initialization occurs in line 40, using the data statement in line 1220, and should be done once at the beginning of your main program.

Lines 50 through 130 form a simple demonstration program that stores each word as it is typed in together with its code word. The original word and the code word are stored in arrays E\$( ) and R\$( ), respectively. Each time you add a word, the program prints out all words that have the same code word, finding them by doing a linear search through the code words.

### The Soundex Subroutine

The Soundex subroutine appears in lines 1000 through 1220. Lines 30 and 40 are also needed to initialize array

W. The first letter of E\$ is put into R\$. If the length of E\$ is 0 (null string) or 1, then the subroutine terminates (line 1050). Otherwise each character of E\$, starting at the second character, is scanned and its group code is put into the intermediate string S\$ unless the character is not a letter or the letter falls in group 0. For example, if we type SOMMERSET, when the program gets to line 1130, S\$ will contain S55623. Next, consecutive occurrences of the same group number will be reduced to a single occurrence of that number. Thus the 55 in S55623 will become a single 5. When the program gets to line 1200, the string R\$ will be S5623. Line 1200 truncates the string R\$ to four characters, becoming S562, which is the code word for SOMMERSET. Let's take another look at the steps, shown *before* the execution of each line:

Group	Letters
0	A E I O U H W Y
1	B F P V
2	C G J K Q S X Z
3	D T
4	L
5	M N
6	R

Table 1

line	S\$	R\$
1030	null	S
1130	55623	S
1200	55623	S5623
1210	55623	S562

This algorithm has some serious limitations. Although our "Johnson" examples work fine, with the resulting code for the different spellings being J525, "phone" and "fone" do not give the same code because they start with different letters; "Rogers" and "Rodgers" do not work because the *d* is not in the same code group as *g*. And words like "tough" and "tuff" do not translate to the same code because *g* and *f* are in different code groups. But the Soundex algorithm works well for most words and proper names.

To try the Soundex algorithm, enter the program in listing 1 and run it. Type in some names. Every time you type a new name, the program will list on the screen all the words entered that have the same Soundex code. If you add the line

```
65 PRINT R$
```

the Soundex code will also be printed.

### Applications

The Soundex subroutine has many applications. If you have a card-file program that searches for items by matching a "key" string, rather than returning the message

MATCH NOT FOUND

or some such, your program could jump into the "Soundex mode," look for matches that sound similar to the key, and then list them. You could then look through the list of near matches to see if the word sought is in the list. This short Soundex subroutine can add a lot of "flash" to what might otherwise be a mundane program. ■

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# What's New?

## SYSTEMS



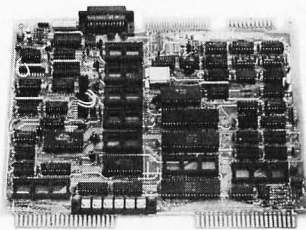
### Multifunction Desktop Computers

The AWS family of multifunction work stations offer 0.5 megabyte of storage. These desktop work stations are based on the 16-bit Intel 8088 microprocessor and carry a combination of floppy- and Winchester hard-disk drives in the same enclosure as the processor and the display screen. Each AWS work station supports up to 512K bytes of RAM (random-access memory) based on 64K-byte RAM integrated circuits, an 80-character by 28-line video-display unit, and an optional mass-storage unit. The units can function as stand-alone terminals or as members of a local network by means of a high-speed data link, sharing peripherals and databases.

In single-units, the AWS work station ranges in price from \$3990 to approximately \$11,500, depending on optional equip-

ment. For additional details, contact Pauline Alker, Convergent Technologies, 2500 Augustine Dr., Santa Clara, CA 95051, (800) 538-7560; in California (408) 727-8830.

Circle 550 on inquiry card.



### Single-Board Computer Can Support 56K Bytes of Memory

The Flexi Plus is a 6809-based single-board microcomputer that can accommodate up to 56K bytes of on-board RAM (random-access read/write memory), ROM (read-only memory), and EPROM (erasable programmable ROM) in any combination. Flexi Plus features extensive serial and parallel I/O (in-

put/output) capabilities, a 20-milliampere current-loop TTY (teletypewriter) port, and a universal cassette interface. When used without its 6809 option, the Flexi Plus can serve as an expansion board for most 6502-, 6800-, or 6809-based systems.

Optionally, the Flexi Plus can be expanded to include an IBM-format-compatible floppy-disk controller that can support up to four 8-inch drives or three 5¼-inch drives. Additional options include an IEEE-488 bus controller and a fully buffered RS-232C communications port with programmable data formats and transfer rates from 50 to 19,500 bps (bits per second).

The Flexi Plus costs \$320. The 6809 and the RS-232C options are available for \$75 each. Both the floppy-disk and the IEEE-488 bus controllers cost \$125. Literature is available on request. Contact Robert M. Tripp, The Computerist Inc., 34 Chelmsford St., Chelmsford, MA 01824, (617) 256-3649.

Circle 551 on inquiry card.

### STD Bus Controller Card

The ZT7805 controller card for the STD bus features an 8085A microprocessor, 1K bytes of programmable memory, up to 8K bytes of ROM (read-only memory), IEEE-488 I/O (input/output) and two serial RS-232C ports, and a control monitor with I/O subroutines. The board

costs \$650. Contact Zia-tech Corp., 2410 Broad St., San Luis Obispo, CA 93401, (805) 541-0488.

Circle 552 on inquiry card.

### Modular Microcomputer

The Sintel-85 is a modular microcomputer training system based on the Intel 8085 microprocessor. It has 2K bytes of ROM (read-only memory) with expandable monitor, 256K bytes of RAM (random-access read/write memory), three programmable I/O (input/output) ports, a 6-digit display with both address and data fields, and a 24-key keyboard with eight command keys and 16 hexadecimal keys.

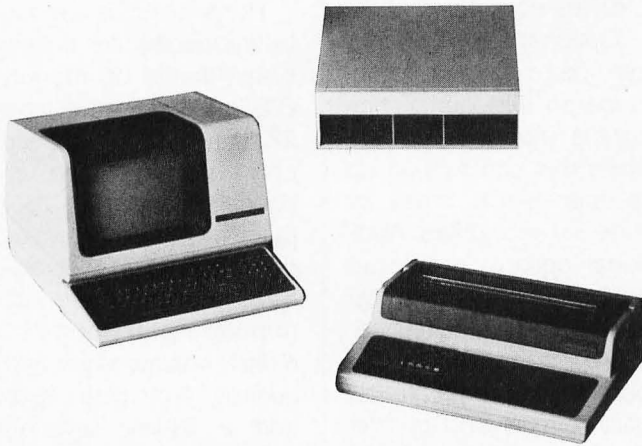
Sintel-85 can be expanded to include up to 64K bytes of memory and 256 I/O ports. A wide range of expansion and interface boards are available, including A/D (analog-to-digital) and D/A (digital-to-analog) converters, cassette interface, an immediate expansion board, and audio-visual I/O ports interface. The immediate expansion board augments the basic system with additional RAM, 4K bytes of EPROM (erasable programmable ROM), two counter/timers, and 44 programmed I/O lines. It includes two 8156 units, two 2114 static RAMs, and sockets for two 2716 ROMs. Also available is an I/O expansion board that lets you exercise and simulate I/O instructions, external systems operation, and program debugging. An oscillator lets you oper-



# What's New?

ate a small speaker. For more details, contact Beth Belkin, Government of Israel Trade Center, 350 Fifth Ave., New York, NY 10118, (212) 560-0661. In

Israel, contact Sintel Systems Ltd., 13 Ovadia St., POB 9209, Haifa, Israel 34564, (04) 334944; Telex: 46400 BXHA IL, ext. 8134. Circle 553 on inquiry card.



## Business System Has Three Z80s

The ARCmicro is a small-business microcomputer system with three separate Z80 microprocessors: the system processor, the disk processor, and the terminal processor. The system supports two 5¼-inch Winchester disks for a total of 20 megabytes of formatted storage and four 5¼-inch double-sided, double-density floppy-disks totaling 3.2 megabytes of storage. System memory is expandable from 64K bytes to 256K bytes. The terminal processor controls all video-display units, printers, and communications links with the system processor, which frees the system processor from interrupts and increases communications throughput.

Other features of the ARCmicro include a shadow ROM (read-only memory) that contains self-

diagnostics and bootstrap programs that execute during system initialization. The self-diagnostic programs perform memory and peripheral device tests to assure integrity each time the system is initialized. The ROM then "disappears" from the address space and is available for use by the program memory.

The ARCmicro is currently available as a complete microcomputer system called the ARCmicro/PAC, which includes a DEC (Digital Equipment Corporation) VT-101 video display, a DEC LA-34 printer, and either the CP/M 2.2 or the MP/M II disk operating system. Contact ARC Automation Group Inc., POB 1009, Bryan, TX 77805, (713) 693-6122. Circle 554 on inquiry card.

## SOFTWARE

### Step FORTH to RPL

RPL is a FORTH-like language that runs on PET and CBM (Commodore Business Machines) computers. RPL (Reverse Polish Language) uses the Commodore BASIC screen editor for program entry and editing, but does not inhibit the use of BASIC throughout a software development session. The RPL Compiler and the screen-oriented, object-level Symbolic Debugger reside in the top 8K bytes of memory and can be called directly from BASIC commands. Source code is saved to disk or cassette and is compiled memory-to-memory.

RPL has special keywords and symbols that let you nest multiline IF... THEN... ELSE constructs and FOR... NEXT loops. Other special keywords and symbols offer named subroutines and functions of arbitrary length, 16-bit integer arithmetic and logical manipulations, built-in character-string handling, stack-management directives that include *n*-index and *n*-rotate, access to machine language, predefined arrays with numeric and string contents, local and global symbols, and forward and backward symbolic references, including GOTO. Also provided are GET, INPUT, and PRINT operators.

The RPL Compiler, including a 60-page user's manual, is available on disk for \$49.95 or on cassette for \$44.95. The complete

Compiler and Symbolic Debugger costs \$80.91 on disk or \$71.91 on cassette; manuals are available for \$10 and \$4, respectively. For details, contact Samurai Software, POB 2902, Pompano Beach, FL 33062, (800) 327-8965, ext. 2; in Florida (305) 782-9985. Circle 555 on inquiry card.

### Take Your Projects to Task

Task is a management tool to help you schedule a project. It combines the procedures of PERT (Performance, Evaluation, and Review Techniques) and the Critical Path Method, which divides a complex project into assignments and determines which are critical to the overall completion of the project. Task determines the scheduled start and completion dates for each assignment in a project, which tasks cannot be delayed if the project is to be completed on time, and the amount of time each noncritical task can be delayed without affecting the completion date of a project. Among the options included with Task are the ability to create a calendar to work with a particular work schedule, an expanded Gantt diagram, and a management report that can detail each task, including its start and finish times.

Task is a compiled program running under CP/M. It costs \$329 and is available from AMSI, Suite 200, 1935 Cliff Valley Way NE, Atlanta, GA 30329, (404) 634-9535.

Circle 556 on inquiry card.



# What's New?

## Overlay Compiler

An overlay structure is now possible with North Star BASIC under an extension to the Comstar compiler. Overlay structures differ from program chaining in that a root program segment and selected program variables remain intact when a new program segment is introduced. Overlay structures permit large programs to be executed.

The Overlay extension is suitable for menu-driven programs and includes a Comstar-CP/M capability. The Overlay extension is available to registered owners of the Comstar compiler for \$75 from Allen Ashley, 395 Sierra Madre Villa, Pasadena, CA 91107, (213) 793-5748. Circle 557 on inquiry card.

## Smartkey for CP/M and Software Applications

The Smartkey is a keyboard utility for the CP/M operating system that solves the problem of incompatibility between the console keyboard hardware and applications software. The program acts as an interface between the keyboard and CP/M by allowing the user to "redefine" the keyboard. Codes generated by individual keys can be changed at will or made to generate a sequence of characters at each keystroke. The keyboard's layout can be improved or customized for particular applications software, and sets of key definitions can be saved to

disk for later use. Definitions can be altered at any time.

Smartkey does not require hardware or software knowledge to install or use. It's available for \$39 from FBN Software, 1111 Sawmill Gulch Rd., Pebble Beach, CA 93953, (408) 373-5303.

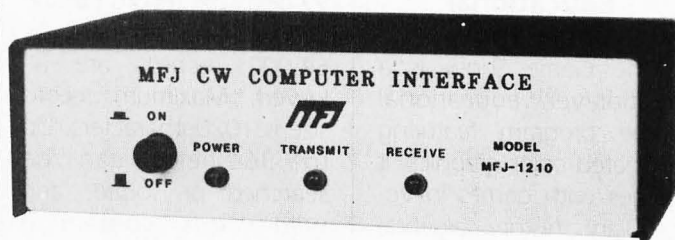
Circle 558 on inquiry card.

## Mail-List Manager

The One-Disk Mail-List Manager is a mailing-list management and a label-printing utility for Radio Shack's TRS-80 Models I and III. The program disk can hold 430 records that include name, company, address, and zip code. Records can be sorted alphabetically or by zip code using machine language at a speed of 100 records every 3.5 seconds. Entries are made on a first-name-first basis, and multiple entries are handled by single-keystroke repetition of the address. Labels can be printed from sorted or unsorted lists and by any combination of selection fields. Other features include a label-selecting Print Key that can print labels for any geographic area (i.e., city, state, or zip code).

The One-Disk Mail-List Manager requires 32K bytes of memory; conversion to Model III DOS is necessary. It costs \$34.95 and is available from Manhattan Software, POB 1063, Woodland Hills, CA 91365. MasterCard or Visa holders can order by calling (213) 704-8495.

Circle 559 on inquiry card.



## Continuous Wave Interface for TRS-80

MFJ Enterprises' CW (continuous wave) Transceive Program and Hardware Interface lets you send CW on your keyboard and receive CW on your video-display screen. It features a tri-split screen for received messages, transmit buffer, and programmable message index. Its text buffer can hold 3295 characters when used with a 16K-byte machine, and it can be preloaded while receiving messages. The package has ten 199-character programmable message memories with on-screen message index. Messages can be repeated or combined, and speed is adjustable from 12 to 55 words per minute (wpm). For group-code practice, up to 2200 characters can be stored. The package automatically receives up to 100 wpm and allows you to store up to five screens of received CW. When the transmit buffer is empty, the mode is automatically changed to receive.

MFJ's hardware interface plugs between the transceiver and the computer without modifications. The cassette-based, disk-compatible program and the hardware-interface package run on a 16K-byte

TRS-80 Model I or III. The Transceiver and Hardware Interface costs \$99.95, plus a \$4 shipping charge. Contact MFJ Enterprises Inc., POB 494, Mississippi State, MS 39762, (601) 323-5869. MasterCard or Visa holders can order by calling (800) 647-1800.

Circle 560 on inquiry card.

## Let Your Modem Do the Talking

The automated sales force at Telephone Software Connection delivers its products at any time of the day or night over telephone lines. The Connection's Apple-compatible software comes with complete documentation embedded in the programs. The Connection presently offers telecommunications software, games, and educational programs, as well as utilities for the Apple II. Several free programs are offered by means of the telecommunications hook-up.

For more information, contact Telephone Software Connection Inc., POB 6548, Torrance, CA 90504, (213) 516-9430. The telephone number for the modem connection is (213) 516-9432. Payment is by credit card.

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# What's New?

## Educational Game Show

The Game Show is a multiplayer educational game program featuring animated color graphics. It comes with games in vocabulary, history, algebra, sailing, and computer terms. An authoring system that lets you add your own topics is provided.

The Game Show runs on the Apple computer. It costs \$45, which includes documentation, a one-year warranty, and a backup disk. Available at computer dealers or directly from Computer-Advanced Ideas Inc., Suite 341, 1442A Walnut St., Berkeley, CA 94709, (415) 526-9100. Circle 562 on inquiry card.

## Profile III +

The Profile III+ is a database management package for Radio Shack's TRS-80 Model III computer. It can communicate with Personal Software's Visicalc financial-modeling program and with Radio Shack's Superscript word-processing program. This combination gives the Model III owner a complete management-information tool.

Profile III+ is menu-driven with user options appearing at the bottom of the screen. Customized or special limited menus can be created. The system's screen editor lets database designers visually organize an input screen, and fields and user prompts can be moved by means of function keys. Screens can be password-protected. Up to

99 fields per record can be defined, and as many as 64,000 records are allowed. Maximum record size is 1020 characters. Up to 36 fields can be searched or sorted, and wild cards containing partial-field values are permitted.

Profile III+ requires a 48K-byte TRS-80 Model III with a single disk drive. It costs \$300, which includes manufacturer-supplied updates. Contact The Small Computer Company Inc., 40 West Ridgewood Ave., Ridgewood, NJ 07450, (201) 445-5643.

Circle 563 on inquiry card.

## Integrate Real-Time Software Tasks

The Multi-Tasking Kernel is a tool for integrating multiple real-time software tasks in 8085-, Z80-, 6502-, 6800-, and 6809-based microcomputer products. The package includes source code for a basic multitasking organization in which tasks self-schedule in a round-robin fashion. The package provides the user with guides through a series of enhancements for carrying out sophisticated, interrupt-initiated, preemptive priority dynamic-task scheduling. Also included are descriptions of dedicated and shared resource scheduling, time-slice scheduling, and intertask communication schemes.

The Multi-Tasking Kernel costs \$195, which includes assembly-language source-code implementations for the 8085, Z80, 6502, 6800, and 6809 micropro-

cessors. Contact US Software, 5470 Northwest Innisbrook Pl., Portland, OR 97229, (503) 645-5043.

Circle 564 on inquiry card.

## BASIC Editor for TRS-80s

EDIT is a full-screen BASIC editor for Radio Shack's TRS-80 Models I and III. It features a floating-point cursor with automatic repeat functions and a Scipsit-like control structure for easy handling. More than 30 commands permit professional-quality editing of BASIC text at the character, word, line, or block level.

EDIT was developed in England by Southern Software. It costs \$40 and is being distributed in the U.S. by Allen Gelder Software, POB 11721, Main Post Office, San Francisco, CA 94101.

Circle 565 on inquiry card.

## Insurance Rating Programs

Orion Business Systems' Orionrater programs could make the insurance agent's rating book a piece of the past. This series of property and casualty rating programs can quickly compare and print out quotes. They are simple to operate and do not require insurance or technical backgrounds. Among the programs available are Auto insurance, Homeowners/Condo Owners and Renters insurance, Commercial Truck insurance, and Commercial Liability insurance.

Most Orionrater programs run on 48K-byte Apple II Plus computers equipped with a disk drive and controller, a monitor, and a printer. Prices range from \$475 to \$750. For complete specifications, contact Orion Business Systems, Suite 102, 11777 Bernardo Plaza Court, San Diego, CA 92128, (714) 485-8580.

Circle 568 on inquiry card.

## C/80 Compiler

C/80 is a compiler for the C programming language that provides random-access file I/O (input/output) and Macro-80 compatibility. It generates 8080 assembly-language code for the assembler or for Micro-soft's Macro-80 relocatable assembler and linking loader. All C language control statements and arithmetic and logical operators are supported as well as character and 16-bit integer data, pointers, arrays, strings, data initialization, inline assembly language, conditional compilation, and most preprocessor functions. C/80's run-time library provides standard C I/O functions and features dynamic storage allocation, I/O redirection, and a run-time execution-profile facility for easy program optimization.

C/80 lacks structures, pointers to pointers, and long and floating data types. Available on 8-inch CP/M disks and on 5¼-inch Heath/Zenith CP/M or HDOS disks, C/80 costs \$39.95. Contact The Software Toolworks,



# What's New?

14478 Glorietta Dr., Sherman Oaks, CA 91423, (213) 986-4885.  
Circle 569 on inquiry card.

## Atari Graphics Composer

The Graphics Composer is a joystick/paddle graphics software package for Atari 400/800 microcomputers. With it you can draw the outline of a picture in high-resolution screen mode 8 or 7 using a joystick or paddle; then you can use color fill-in, color brushes, and text to complete your graphics scheme. The graphics can then be saved to disk or cassette.

Graphics Composer is supplied with a Geometric Figures program that allows you to define circles, triangles, polygons, parallelograms, and trigonometric curves. Graphics Composer is available in both cassette and disk versions for \$39.95. It requires 32K bytes of programmable memory. Contact Versa Computing Inc., Suite 104, 3541 Old Conejo Rd., Newbury Park, CA 91320, (805) 498-1956.

Circle 570 on inquiry card.

## New C Compiler

Phase One Systems has unveiled a C compiler for its Oasis operating system. Oasis C supports most Unix Version Seven C features. It produces Z80 assembler code and is provided with an optimizer that reduces compiled code between 30 and 50%. Among the attributes of Oasis C are

pointers, structures, assignment operators, a full I/O (input/output) library, and compile options. A version of Oasis C for the 16-bit-compatible Oasis-16 will be available.

Oasis C costs \$250. For complete details, contact Phase One Systems Inc., Suite 830, 7700 Edgewater Dr., Oakland, CA 94621, (415) 562-8085.

Circle 571 on inquiry card.

## PERIPHERALS

### Model III Cash-Register Expansion System

The CR-180 is a cash register/point-of-sale expansion system for the TRS-80 Model III microcomputer. It stores transactions for up to 100 employees, saves eight methods of payments, and provides inventory control and complete reporting. The CR-180 can produce daily sales and cash reports by employee and by type of transaction, inventory usage reports, and gross profit computation. Also, price and shelf labels can be printed.

The CR-180 expansion system is supplied with an electronic cash drawer and a receipt printer which plug directly into the TRS-80 Model III. Audio has been added for keystroke confirmation. Prices range from \$900 to \$1900. Contact Integrated Cash Register/Futuresoft, Southern Region, Suite 203, 2301 Park Ave., POB 1446, Orange Park, FL 32073, (904) 269-1918.

Circle 572 on inquiry card.



### Draft- and Letter- Quality Printer

Printer Systems' Model 1800 printer can produce both correspondence- and draft-quality printouts. It is plug-compatible with IBM Series I or System 34/38 computers as well as Univac, Burroughs, Honeywell, DEC (Digital Equipment Corp.), and Data General computers. In the draft mode, the Model 1800 prints at 200 cps (characters per second) with a 7 by 9 dot-matrix format. In the correspondence mode, it prints at 50 cps in a 40 by 18 format. The Model 1800 features a forms-length selector switch and quiet operation.

The Model 1800 printer is available for \$2695 from Printer Systems Corp., Suite 104, 1 West Deer Park Rd., Gaithersburg, MD 20760, (301) 840-1070.

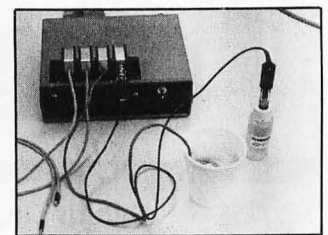
Circle 573 on inquiry card.

### I/O Control Card

The G519 I/O card is an interface between the Multibus and Gordos industry-standard PB-16/PB-24 I/O (input/output) module boards. The card

can control up to 72 AC or DC input or output modules in any combination or position on the I/O module board. It can also serve as a general-purpose TTL (transistor-transistor logic) interface card for control of up to 72 bidirectional I/O lines.

Gordos International also has interface cards for the RM-65, the Exorcisor II, and STD bus. The G519 I/O card is priced at \$500. For details, contact Gordos Corp., 250 Glenwood Ave., POB 100, Bloomfield, NJ 07003, (201) 743-6800. Circle 574 on inquiry card.



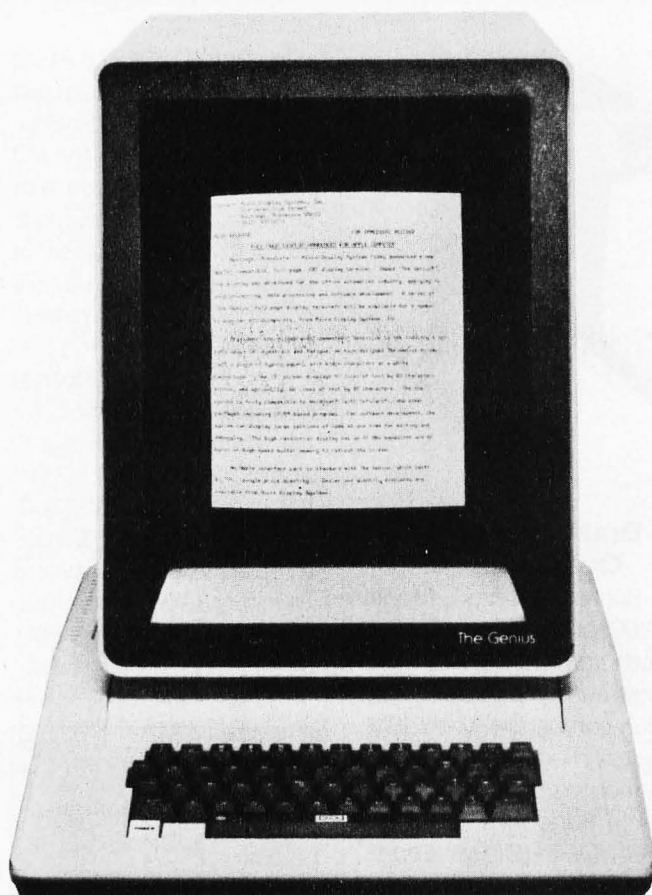
### Analog Peripheral

The Analog Peripheral is a self-contained 8-bit A/D (analog-to-digital) converter that can connect to any computer. It has a switch-selectable RS-232C output line with data transmission rates from 110 to 9600 bps (bits per second). Other features include a 26-pin parallel output, four input channels, conversion speeds of 100 microseconds, power supply, and plug-in sensors for temperature, light and other analog signals. For complete details on the Analog Peripheral, contact Cambridge Development Laboratory, 36 Pleasant St., Watertown, MA 02172, (617) 926-0869.

Circle 575 on inquiry card.



# What's New?



## Genius Display System

The Genius is an Apple-compatible, full-page video-display terminal. The 15-inch Genius displays 57 lines of text by 80 characters, or optionally 66 lines by 80 characters. The Genius is compatible with the Wordstar word-processing system and many CP/M-based programs. Large sections of code can be displayed at one time, which is a plus for software

developers, and the high-resolution display has an 87 MHz bandwidth and 6K bytes of high-speed buffer memory.

The Genius is supplied with an Apple interface card. It is available for \$1795 from Micro Display Systems Inc., 514 Vermillion St., Hastings, MN 55033, (612) 437-2233.

Circle 576 on inquiry card.

## Single-Pen Drum Plotter

The Complot CPS-20 is a single-pen, 11-inch drum plotter that can interface with most computers. The only alteration needed to use the CPS-20 with different computers is the switching of a single interface card. The high-effi-

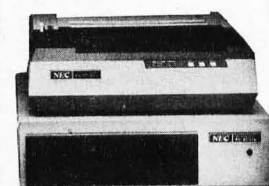
ciency CPS-20 operates at 3 inches per second at a resolution of 0.005 inch. It costs \$3995. Contact Houston Instrument, One Houston Square, Austin, TX 78753, (512) 837-2820. Circle 577 on inquiry card.

## Line Controller Adds Voice Synthesis

The SLC-II is a serial line controller that combines microprocessor intelligence with a versatile voice-synthesis capability. The controller can automatically dial telephone lines and talk by means of its electronically synthesized voice. It can listen and respond to incoming messages that originate at a remote terminal or are generated by a telephone keypad. The SLC-II's vocabulary includes more than 300 words as well as the complete alphabet and numerals, and it will spell any word it cannot say.

The SLC-II provides ASCII input/output, Touch-Tone input, printer output, external amplifier output, and synthesized voice output. A built-in power backup is provided by rechargeable batteries. In addition, the SLC-II features an auto-dial/auto-answer modem; 16K, 32K, or 80K bytes of programmable memory; and automatic time and date entry with day, month, and year. Applications include data collection and transmission, telephone access to large databases, alarm signaling, and security or facility monitoring. Connections to existing computer systems are made by standard RS-232C or 20 mA serial-loop interface.

In single-unit quantity, the SLC-II costs \$1975. Contact Digital Pathways Inc., 1260 L'Avenida, Mountain View, CA 94043, (415) 969-7600. Circle 578 on inquiry card.



## Dot-Matrix Printer

NEC Home Electronics' PC-8023A dot-matrix printer can bidirectionally print the upper- and lower-case ASCII (American Standard Code for Information Interchange) character set featured on the PC-8001A microcomputer. In addition, the printer provides many Greek, mathematical, and graphics symbols. The high-speed PC-8023A is equipped with a standard parallel interface and features the ability to print dot-graphics screens on paper. Up to three copies of fanfold, roll, or cut-sheet paper and originals are possible using either pin- or friction-feed delivery. Paper widths range from 11.5 to 25 cm (4½ to 10 inches).

The PC-8023A's matrix options include 7 by 9 English or 8 by 8 graphic and dot graphic, ranging from 40 columns by 4 characters per inch to 136 columns by 17 characters per inch. Print speed is 100 cps (characters per second), and all fonts fea-



# What's New?

ture fixed- or proportional-spacing format options at 6 or 8 lines per inch, plus  $\frac{1}{44}$ -inch incremental line feed.

The PC-8023A printer costs \$795. Contact NEC Home Electronics USA, Personal Computer Division, 1401 Estes Ave., Elk Grove Village, IL 60007, (312) 228-5900.

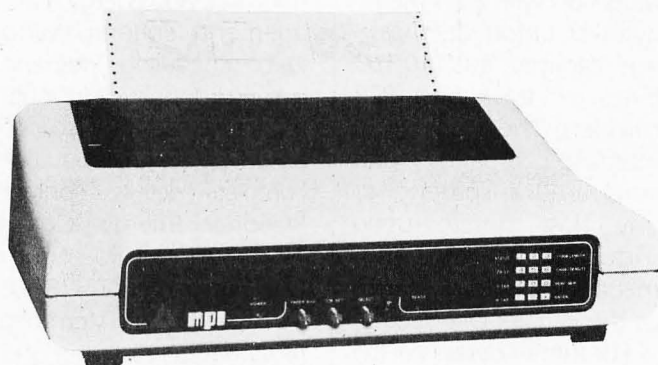
Circle 579 on inquiry card.

## Apple II ROM Board

The Andromeda ROM (read-only memory) Board lets you plug utility programs into your Apple II and access them without loading from disk. The Board has space for 2K- or 4K-byte PROMs (programmable read-only memories) and it can accommodate 2K-byte programmable memory devices. (This gives you read/write capabilities for developing custom PROM programs.) Two 2732 PROMs allow a total of 8K bytes of memory on the ROM Board.

The ROM Board is supplied with a utility ROM that gives you five options with your Applesoft programs: you can perform automatic line numbering, alphabetize a disk catalog, control a program list with a page mode, restore crashed Applesoft programs in memory, and create a disk without using the disk operating system. The ROM Board with utility ROM costs \$125 and is distributed by Computer Data Services, POB 696, Amherst, NH 03031, (603) 673-7375.

Circle 580 on inquiry card.



## Heavy-Duty Printer

The Model MP150 matrix printer has a heavy-duty print head, rated for continuous duty, with an expected life in excess of 100 million characters. Characters are formed bidirectionally in a logic-seeking mode to optimize system throughput. Nine print wires provide clear characters with true descenders and underscores. The MP150 can print 136 characters per line at 10 characters per inch, or up to 226 columns can be printed by selecting the 12- or 16.7-character-per-inch density. Double-width characters are software-selectable. A 7 by 9 matrix font is used for high-speed data printing and an 11 by 9 serif-style matrix font can be used for high-quality printouts. The MP150 features the standard 96-character ASCII (American Standard Code for Information Interchange) set with four strap-selectable foreign fonts.

The MP150 is capable of high-resolution dot-addressable graphics for plotting, printing of screen graphics, and drawing of illustrations. Forms handling

is carried out by a stepper-motor-drive tractor paper feed that can be adjusted to accept forms from 7.5 to 38 centimeters (3 to 15 inches) in width. Eight user-selectable forms lengths, skip-over-perforation, and six user-selectable character densities are featured.

The MP150's 1K-byte buffer is expandable to 8K bytes, and its Centronics-type interface can accept parallel TTL (transistor-transistor logic) level data at over 1000 characters per second. Optionally, an RS-232C serial interface can be added to the MP150. The RS-232C interface can accept data at any one of seven rates up to 9600 bps (bits per second) and it supports X-ON/X-OFF and ETX/STX protocols. Another option is an IEEE-to-Centronics interface adapter card for connecting devices with an IEEE-488-bus output port.

The Model MP150 printer costs \$1095. Contact MPI, 4426 South Century Dr., Salt Lake City, UT 84107, (801) 263-3081.

Circle 581 on inquiry card.

## Universal Systems Interface

The Shugart Associates Systems Interface (SASI) is a universal interface that allows streaming-tape cartridge and floppy- and Winchester-disk drives to use a standard system interface. SASI eliminates having to develop new controllers, host adapters, and software drivers each time a new memory device is integrated into a system. Other SASI operating features include the ability to attach up to eight host processors and controllers per SASI bus, a search capability to assist file-management systems in locating key parameters, multiple command types, and self-arbitration for control of the SASI bus on a memory-device-priority basis.

SASI is already available on Shugart's SA1400 Series of disk-drive controllers.

In OEM (original equipment manufacturer) quantities, the price for Shugart's SA1400 series of disk-drive controllers with an SASI interface begins at \$565. For complete details, contact Shugart Associates, 475 Oakmead Parkway, Sunnyvale, CA 94086, (408) 733-0100.

Circle 582 on inquiry card.

## Scorpio Family

The Scorpio family of 8-inch Winchester disk drives from Ampex have an average access time of 30 milliseconds with a data-transfer rate of 1.2 megabytes and an average latency of 8.3 milliseconds. This is achieved by means



# What's New?

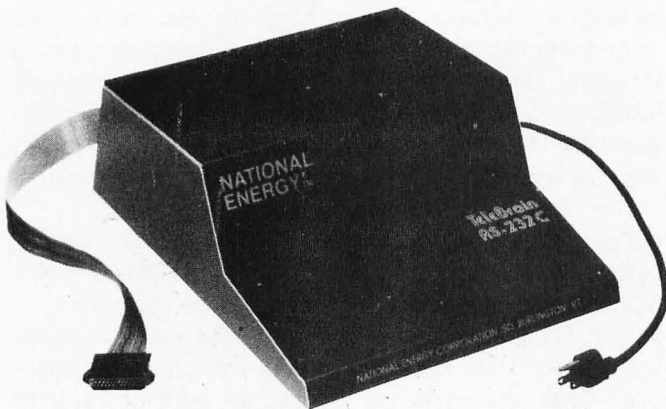
of a linear voice-coil actuator in a closed-loop servo system. All critical components are enclosed in a sealed module to assure long-term reliability and data integrity. Additional features ensuring data integrity include head-landing zones, module shock mounting, and self-actuating head-carriage and disk-spindle locks. Mean time between failures is 10,000 hours.

The Scorpio family is available in two versions: Model 48 with 49.7 megabytes of storage and the

Model 80 with 82.9 megabytes of unformatted storage capacity and 20,160 bytes per track over 823 cylinders. The Model 80 is interface-compatible and software-transparent to any host system using industry-standard 80-megabyte disk drives, such as the Ampex DM-980.

For further details on the Scorpio family, contact Ampex Corporation, Memory Products Division, 200 North Nash St., El Segundo, CA 90245, (213) 640-0150.

Circle 583 on inquiry card.



## Wireless Building Automation

The Telebrain RS-232C is a wireless computer interface that can communicate programmed, automated-switching decisions throughout an entire facility using the existing AC wiring. It can transmit switching decisions emanating from a host computer, per software developed by the facility, to any one of 1600 independent control points, or Teleswitches. The Teleswitch receives and identifies the command and performs the necessary switching.

Telebrain incorporates National Energy's Solution 100 and Solution 1600 programs and the Telegain amplifier. The Solution 100 software includes independent programmable control of up to 83 unique points allowing for 7-day programming, daily start-up, shut-down, and duty cycling. Telebrain can interface with any computer that has an RS-232C serial output port.

Applications include facility management and automation including lighting control, activation of security systems, materials

handling, and energy management encompassing load scheduling, demand limiting, duty cycling, optimum start-up, and so on, based on analog input. For complete details, contact National Energy Corp., 1795 Williston Rd., South Burlington, VT (800) 451-3410; in Vermont (802) 658-6445.

Circle 584 on inquiry card.

## Color Word-Processing System

NEC Home Electronics' color word-processing system features a self-teaching program and a 12,000-word dictionary. The system is menu-driven, which reduces the possibility for errors, and features all-green text, instructions in yellow or blue, and violet-highlighted potential deletions. The system provides automatic page numbering, draft printing without leaving the document, stock-paragraph and form-letter appending to any document, automatic disk-overflow routine, user-oriented document name listing, unlimited headers and footers, disk-supply indicator, single-key commands, and block move, copy, delete, write, print, and justification capabilities.

When combined with NEC's PC-8001A micro-computer, color monitor, printer, I/O (input/output) unit, and a disk drive, the color word-processing system adds the final touch to a complete computer system that costs less than

\$6000. Contact NEC Home Electronics USA, Personal Computer Div., 1401 Estes Ave., Elk Grove Village, IL 60007, (312) 228-5900, for complete details.

Circle 585 on inquiry card.

## Portable Terminal Has Modem and Printer

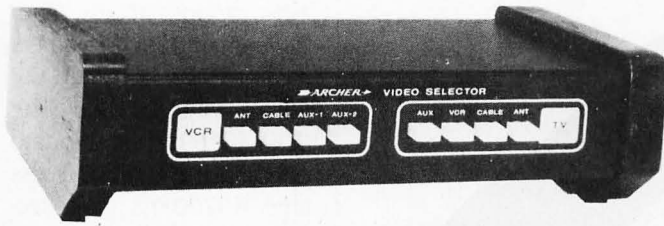
Business people will find the Lex-21 portable printing and communications terminal useful in providing access to remote computing services, in field service, for inventory checks, accounting systems, electronic mail, and up-to-the-minute price quotations. Lex-21 features a 59-key ASCII (American Standard Code for Information Interchange) keyboard and a 40-column thermal printer with upper- and lowercase descenders and a 5 by 7 dot-matrix character format. It has a built-in full-duplex 300 bps (bits per second) modem with originate or answer modes, Bell 103A compatibility, and an FCC-approved handset connection. Its industry-compatible asynchronous communications protocol allows transmission at 10 or 30 characters. Its battery-backed memory includes a 1K-byte receive buffer and 2K bytes of compose and edit memory.

The Lex-21 costs \$1195. For details, contact Lexicon Corporation, 1541 Northwest 65th Ave., Fort Lauderdale, FL 33313, (305) 792-4400.

Circle 586 on inquiry card.



# What's New?



## Video Selector

The Archer Video Selector is a compact, push-button video-switching and control center designed to eliminate the need to repeatedly change cable connections. It simplifies signal routing even for complex home video systems. Two banks of push buttons provide the necessary switching and signal routing between four 75-ohm coaxial inputs and one phono jack to three 75-ohm coaxial outputs. The inputs permit the connection of any combination of five video sources, such as cable television, an

antenna, a videocassette or videodisc player, a camera, and a small computer. The three outputs allow simultaneous viewing and recording of a selected input.

The Archer Video Selector offers a signal-path bandwidth from 50 to 900 MHz. No power is required. The Archer Video Selector costs \$79.95 and is available at Radio Shack stores and participating dealers. Contact Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3300.

Circle 587 on inquiry card.

## ROM Simulator

Lamar Instruments' ROM (read-only memory) simulator is designed to reside in an Apple II-based development system for use in developing software for another, "target" computer. The device can take the place of a ROM, PROM (programmable ROM), or EPROM (erasable programmable ROM) normally located in the target computer and is useful for developing software eventually destined to be placed in ROM. The ROM simulator connects to the target computer by means of a 24-pin dual-inline package

(DIP) and a ribbon cable.

The double-sided ROM simulator has plated-through holes, silk-screened legends, gold-plated contact fingers, and is solder-masked. It has 2K bytes of high-speed, low-power, CMOS (complementary metal-oxide semiconductor) static programmable memory that resides in hexadecimal C800 to CFFF in the Apple II memory map. It contains the necessary logic to automatically switch control of the address and data bus from the Apple II to Lamar Instruments' Superkim (i.e., target) ROM sockets. The

price is \$295. Contact Lamar Instruments, 2107 Artesia Blvd., Redondo Beach, CA 90278, (213) 374-1673.

Circle 588 on inquiry card.

## Options Package for DS180 Printer

Datasouth Computer's special package of options for its DS180 matrix printer includes graphics, compressed print, display mode, an expanded buffer, and a dot-addressable raster-scan feature that lets you print computer-generated charts and graphics. Under program control, six print wires can be addressed to print high-density output at a resolution of 75 by 72 dots per inch.

In the compressed print mode, the package permits manual or program selection of print sizes including 10, 12, and 16.5 characters per inch as well as expanded modes of 5, 6, and 8.25 characters per inch. This permits the DS180 to print from 132 columns on an 8½-inch form to 217 columns on a 14⅞-inch form.

The display mode lets you print out or "display" the nonprinting ASCII (American Standard Code for Information Interchange) control codes.

The package of options costs \$150. The DS180 printer, which operates at 180 characters per second, costs \$595. Contact Datasouth Computer Corp., 4740-A Dwight Evans Rd., Charlotte, NC 28210, (704) 523-8500.

Circle 589 on inquiry card.

## MISCELLANEOUS



## Wire-Wrap Tool

The Model OK-729 pneumatic wire-wrapping tools feature precision steel drive components enclosed in a Lexan-reinforced case. A positive indexing mechanism with adjustable stop location and a 6-foot (2-meter) flexible air hose are provided. The OK-729 is available in two versions: a 5000 RPM (revolutions per minute) version and a model with a higher torque and a speed of 3000 RPMs for cut/strip/wrap applications. Both versions are designed to operate at 80 to 100 pounds per square inch and are fully rated for heavy-duty applications on wire as large as 18 AWG (American Wire Gauge) or for more delicate work on wire as small as 30-32 AWG.

The OK-729 wire-wrap tool is available for \$188.57. Contact OK Machine and Tool Corp., 3455 Conner St., Bronx, NY 10475, (212) 994-6600. Circle 590 on inquiry card.

## New EEPROM

The ER5716 EEPROM (electrically erasable programmable read-only memory) is the newest member of General Instrument Microelectronics' line



# What's New?

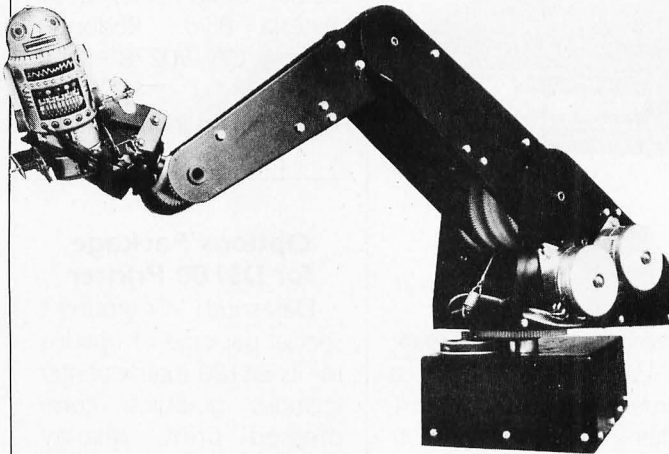
of electrically alterable nonvolatile memories. It's based on N- (negative-) channel silicon-gate MNOS (metal-nitride-oxide semiconductor) technology and is designed for applications that require a large (16K-bit) memory, such as microprocessor-program storage, where nonvolatility is essential but occasional data changes must be made. The ER5716 features improved access time and infinite read capabilities. It is bulk-erasable and can be electrically reprogrammed.

The ER5716 EEPROM is available in single units at General Instrument dealers. In OEM (original equipment manufacturer) quantities, it costs \$35.70. Contact General Instrument Corp., Microelectronics Div., 600 West John St., Hicksville, NY 11802, (516) 733-3107, for additional information. Circle 591 on inquiry card.

## Cope with Scopes

The XYZs of Using a Scope will not only show you how an oscilloscope works, but how to make one work for you. Divided into two sections, the primer first covers the nuts and bolts and oscilloscope control functions, then expands to demonstrate waveforms, waveshapes, and measurement techniques.

The XYZs of Using a Scope is available free from Tektronix Inc., POB 4828, Portland, OR 97208, (800) 547-6711; in Oregon (800) 452-6773. Circle 592 on inquiry card.



## Robotics Arm for Education and Hobby

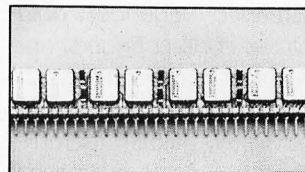
Colne Robotics of England recently introduced the Armdroid I, an educational and hobbyist manipulating arm. The arm has five axes of rotation (base, shoulder, elbow, wrist up and down, and wrist rotate), a three-finger gripper, and is completely stepper-motor-driven. The Armdroid I will operate with any microcomputer, requiring only a latched 8-bit parallel port to interface. The arm has a 17-inch reach, can lift 10 ounces, has a gripping force of 5 pounds and a resolution of 0.15 inch.

Colne Robotics intends to produce a newsletter for owners of the arm, as well as introduce new products to enhance the arm, such as tactile sensors for closed-loop operations. The Armdroid I can be easily modified to accept experimental devices such as alternate gripper devices, tactile sensors, micro switches, and potentiometers.

The Armdroid I is avail-

able in kit form for \$595 and includes Z80 machine-language driver software for the TRS-80 Model I and the power/interface board kit. An assembled version is also available for \$695. For further information, contact Colne Robotics Inc., 207 Northeast 33rd St., Ft. Lauderdale, FL 33334 or Colne Robotics Co. Ltd., 1 Station Rd., Twickenham, Middlesex TW1 4LL, England, 1-892-7044; Telex: 8814066 GCIC.

Circle 593 on inquiry card.



## High-Density Memory Requires Less Space

Electronic Designs' EDH-4816 is a 128K-byte high-density memory that requires only one fifth the area of an equivalent DIP (dual inline package). The EDH-4816 consists of eight

industry-standard 16K by 1-bit random-access read/write memories in carriers mounted on a 32-pin SIP (single inline package). The EDH-4816 has all standard operating modes. Access time is 200 ns (nanoseconds); cycle time is 375 ns.

In single-unit quantities, the EDH-4816 costs \$68. In 100-unit quantities, the price is \$59. Contact Electronic Designs Inc., 230 Elliot St., Ashland, MA 01721, (617) 881-5244. Circle 594 on inquiry card.

## TRS-80 Network

Radio Shack will use ARCNET to provide a low-cost, high-speed local network for the TRS-80 Model II microcomputer. ARCNET is the local network component of Datapoint's ARC (Attached Resource Computer) system. ARCNET provides an inexpensive, efficient means to link a large number of computers together. Each computer in the ARCNET can access common databases, such as accounting, word-processing information or electronic filing systems, and share peripherals (printers, for example) throughout the network. In addition to Datapoint's new LSI integrated-circuit network interface, Radio Shack will use ARCNET protocols and software for cost-effective, high-speed common-resource networking. The ARCNET will permit as many as 255 Model IIs and their peripherals to be interconnected.

Datapoint processors and peripherals, such as its



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Product Family	Product Description	Memorex Part Number (3201-1)	CE quant. 100 price per disc (\$)	Athana	BASF	Dysan	IBM	Maxell	Nashua	Scotch 3M	Shugart	Syncom	Verbatim	Wabash	Control Data
Flexible Disc 1s Single Headed Drives Single Density Media	IBM Compatible (128 B/S, 26 Sectors)	3060	1.99	473071	53426	800506	2305830	FD-128	FD-1	740 0	S/A 100	15002	FD34-9000	F111111X	421602
	IBM Compatible (128 B/S, 26 Sectors) w/ W.P.N. & Hub Ring	3062	2.04	—	—	—	—	—	—	740 0	—	—	FD34-9000	—	—
	IBM Compatible (128 B/S, 26 Sectors) REVERSIBLE	3064	2.39	—	—	—	—	—	—	—	—	—	FD34-9000	—	—
	IBM Compatible (128 B/S, 26 Sectors)	1729	3.19	473072	54431	—	—	—	FD-2	740/2-0	—	15150	FD34-9000	F111111X	—
	IBM System 6 Compatible	3066	2.04	473077	54561	800509	1669959	—	—	740 0 D56	—	15003	FD60-9000	F116111X	—
	IBM Compatible (128 B/S, 15 Sectors)	3109	1.99	473073	—	800584	2305845	—	—	740 3600	—	15005	FD36-9000	F112111X	—
	IBM Compatible (512 B/S, 8 Sectors)	3110	1.99	473074	—	800585	1669954	—	—	—	—	15004	FD60-9000	F112111X	—
	Shugart Compatible: 32 Hard Sector w/Hub Ring	3015	1.99	470901	53802	101/1	—	FH1-32	FD-132	740 32	S/A-101	15025	FD32-9000	—	421322
	Wang Compatible: 32 Hard Sector w/Hub Ring	3087	2.49	—	54491	—	—	—	—	740 32FH	—	—	—	F37A111X	—
	CPT 8000 Compatible	3045	2.69	—	—	—	—	—	—	—	—	15226	—	—	—
Flexible Disc 1d Single Headed Drives Double Density Media	IBM Compatible (128 B/S, 26 Sectors)	3090	2.69	474071	54568	3740/1D	—	FD-128/M2100	FD-10	741 0	—	—	FD34-8000	F131111X	423002
	Soft Sector (128 B/S, 26 Sectors) REVERSIBLE	3093	3.69	—	—	—	—	—	—	—	—	—	—	—	—
	Shugart Compatible: 32 Hard Sector	3091	2.69	470801	54596	101/1D	—	FH1-32D	—	741 32	S/A-103	15075	FD32-8000	F33A111X	423322
	Wang Compatible: 32 Hard Sector w/Hub Ring	3086	3.09	—	—	—	—	—	—	—	—	—	—	—	—
Flexible Disc 2s Double Headed Drives Single Density Media	Soft Sector (128 B/S, 26 Sectors)	3113	3.09	—	54428	800814	1766870	—	—	—	S/A-150	15153	FD10-4026	F121111X	—
	Soft Sector (126 B/S, 15 Sectors)	3106	3.09	473477	54226	800815	2736700	FD2-256D	—	742 0	—	15154	FD10-4015	F122111X	424612
Flexible Disc 2d Double Headed Drives Double Density Media	Soft Sector (Unformatted)	3102	3.09	473485	—	DY150	—	FD2-XDM	FD-2D	743 0	—	15103	DD34-4001	—	425002
	Soft Sector (128 B/S, 26 Sectors)	3115	3.09	—	—	—	—	—	—	—	S/A-150	—	—	—	—
	Soft Sector (126 B/S, 26 Sectors)	3103	3.09	473471	54325	800817	1766872	FD2-256D	—	743 0/256	—	15101	DD34-4026	F145111X	425602
	Soft Sector (1512 B/S, 15 Sectors)	3114	3.09	473472	54479	800818	1669044	—	—	743 0/512	—	15100	DD34-4015	F145111X	425612
	Soft Sector (1024 B/S, 8 Sectors)	3104	3.09	473473	54485	800819	1669045	—	—	743 0/1024	—	15102	DD34-4008	F147111X	425622
	32 Hard Sector	3105	3.09	470851	—	101/2D	—	FH2-32D	—	743 32	S/A-151	15125	DD32-4000	F34A111X	425232
	Burroughs B-80 Compatible: 32 Hard Sector	3092	3.09	—	—	—	—	—	—	—	—	—	—	—	—
	Soft Sector (1024 B/S, 8 Sectors) w/Hub Ring	3116	3.49	—	—	—	—	—	—	—	—	—	—	F34A611X	—
	Shugart Compatible: 32 Hard Sector	3181	3.39	—	—	—	—	—	—	—	—	—	DD32-4000	—	—
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Flexible Disc FD Memorex 651 or Equiv Drive Compatible	FD VI (Vinyl Jacketed)	30712003	2.69	470651	—	FDIV	—	—	FD-165	511-0	—	15026	FD65-1000	F61A111X	—
Mini Flexible Disc 1s 5 1/4" Single Headed Drives Single Density Media	Soft Sector (Unformatted)	3401	1.94	475001	54256	104/1	—	MD1	MD 1	744 0	S/A-104	15300	MD525-01	M11A211X	441002
	10 Hard Sector	3403	1.94	475010	54257	107/1	—	—	MD 110	744 10	S/A-107	15325	MD525-10	M41A211X	441102
	16 Hard Sector	3405	1.94	475016	54258	105/1	—	MH1	MD 116	744 16	S/A-105	15326	MD525-16	M51A211X	441162
	Soft Sector (Unformatted) w/Hub Ring	3431	2.14	—	—	—	—	—	—	—	—	—	MD525-01	—	—
	10 Hard Sector w/Hub Ring	3433	2.14	—	—	—	—	—	—	—	—	—	MD525-10	—	—
	16 Hard Sector w/Hub Ring	3435	2.14	—	—	—	—	—	—	—	—	—	MD525-16	—	—
Mini Flexible Disc 1d 5 1/4" Single Headed Drives Double Density Media	Soft Sector (Unformatted)	3417	2.14	—	54646	104/1D	—	—	—	—	—	—	MD525-01	—	—
	10 Hard Sector	3418	2.14	—	54649	107/1D	—	—	—	—	—	—	MD525-10	—	—
	16 Hard Sector	3419	2.14	—	54652	105/1D	—	—	—	—	—	—	MD525-16	—	—
	Soft Sector (Unformatted) w/Hub Ring	3481	2.34	—	—	—	—	—	—	—	—	—	MD525-01	—	—
	10 Hard Sector w/Hub Ring	3483	2.34	—	—	—	—	—	—	—	—	—	MD525-10	—	—
	16 Hard Sector w/Hub Ring	3485	2.34	—	—	—	—	—	—	—	—	—	MD525-16	—	—
Mini Flexible Disc 2d 5 1/4" Double Headed Drives Double Density Media	Soft Sector (Unformatted)	3421	2.59	—	54624	104/2D	—	—	—	S/A-154	—	—	MD550-01	—	—
	10 Hard Sector	3423	2.59	—	54627	107/2D	—	—	—	S/A-157	—	—	MD550-10	—	—
	16 Hard Sector	3425	2.59	—	54630	105/2D	—	—	—	S/A-155	—	—	MD550-16	—	—
	Soft Sector (Unformatted) w/Hub Ring	3491	2.79	—	—	—	—	—	—	—	—	—	MD550-01	—	—
	10 Hard Sector w/Hub Ring	3493	2.79	—	—	—	—	—	—	—	—	—	MD550-10	—	—
	16 Hard Sector w/Hub Ring	3495	2.79	—	—	—	—	—	—	—	—	—	MD550-16	—	—

## Memorex Flexible Discs...The Ultimate in Memory Excellence

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Memorex means quality products that you can depend on. Quality control at Memorex means starting with the best materials available. Continual surveillance throughout the entire manufacturing process. The benefit of Memorex's years of experience in magnetic media production, resulting, for instance, in proprietary coating formulations. The most sophisticated testing procedures you'll find anywhere in the business.

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Each and every Memorex Flexible Disc is certified to be 100 percent error free. Each track of each flexible disc is tested, individually, to Memorex's stringent standards of excellence. They test signal amplitude, resolution, low-pass modulation, overwrite, missing pulse error and extra pulse error. They are torque-tested, and competitively tested on drives available from almost every major drive manufacturer in the industry including drives that Memorex manufactures. Rigid quality audits are built into every step of the manufacturing process and stringent testing result in a standard of excellence that assures you, our customer, of a quality product designed for increased data reliability and consistent top performance.

### Customer-Oriented Packaging

Memorex's commitment to excellence does not stop with a quality product. They are proud of their flexible discs and they package them with pride. Both their packaging and their labeling have been designed with your ease of identification and use in mind. The desk-top box containing ten discs is convenient for filing and storage. Both box labels and jacket labels provide full information on compatibility, density, sectoring, and record length. Envelopes with multi-language care and handling instructions and color-coded removable labels are included. A write-protect feature is available to provide data security.

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Memorex Flexible Discs will be replaced by Memorex if they are found to be defective in materials or workmanship within one year of the date of purchase. Other than replacement, Memorex will not be responsible for any damages or losses (including consequential damages) caused by the use of Memorex Flexible Discs.

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Memorex Flexible Discs are packed 10 discs to a carton and 10 cartons to a case. Please order only in increments of 100 units for quantity 100 pricing. We are also willing to accommodate your smaller orders. Quantities less than 100 units are available in increments of 10 units at a 10% surcharge. **Quantity discounts** are also available. Order 500 or more discs at the same time and deduct 1%; 1,000 or more saves you 2%; 2,000 or more saves you 3%; 5,000 or more saves you 4%; 10,000 or more saves you 5%; 25,000 or more saves you 6%; 50,000 or more saves you 7% and 100,000 or more discs earns you an 8% discount off our super low quantity 100 price. Almost all Memorex Flexible Discs are immediately available from CE. Our warehouse facilities are equipped to help us get you the quality product you need, when you need it. If you need further assistance to find the flexible disc that's right for you, call the Memorex compatibility hotline. Dial 800-538-8080 and ask for the flexible disc hotline extension 0997. In California dial 800-672-3525 extension 0997.

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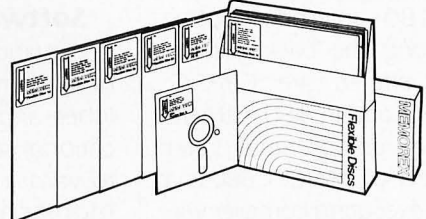
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# What's New?

137-megabyte disk memory and 900-line-per-minute printers, will be compatible with the TRS-80 ARCNET. Also, Radio Shack's bisynchronous communications software packages for the Model II will permit certain IBM and DEC (Digital Equipment Corporation) and other mainframe equipment to link with ARCNET.

Each computer in the TRS-80 ARCNET requires an interface card that installs in an existing card slot on the TRS-80 Model II. The card will be made by Texas Peripherals and will sell for approximately \$400. Other required components are a coaxial cable and a junction box. For further information, contact Tandy Corporation, 1800 One Tandy Center, Fort Worth, TX 76102, (817) 390-3300. Circle 595 on inquiry card.

## Formatted Languages for the VT180

Digital Research has made available formatted language packages for DEC's (Digital Equipment Corporation's) CP/M-based VT180 microcomputer. Among the packages being offered are CBASIC, CB80, and PL/I-80. CBASIC is a compiler-interpreter dialect of BASIC. CB80 is a fast-executing compiler version of CBASIC that provides full support for MP/M. PL/I-80 is an implementation of subset G of the PL/I programming language. These products are available at Digital Research dealers or directly from

Digital Research, 130 Central Ave., Pacific Grove, CA 93950, (408) 649-3896. Circle 596 on inquiry card.

## PUBLICATIONS

### Planning Guide for Educators

A Planning Guide to Successful Computer Instruction is an aid for planning and evaluating the use of computers in the classroom. Written for teachers and administrators, the guide suggests criteria for assessing available computer and microcomputer hardware and software for instructional purposes. Among the topics covered are computer instruction site development and management and sources of hardware and software for education use.

A Planning Guide to Successful Computer Instruction costs \$19.95. Contact Electronic Courseware Systems, POB 2374, Station A, Champaign, IL 61820, (217) 359-7099. Circle 597 on inquiry card.

### Educational Software Catalog

Aquarius Publishers is a new company that publishes and distributes educational software oriented toward junior and senior high-school students. Most of the programs run on TRS-80 and Apple II microcomputers. For a free catalog, contact Aquarius Publishers, POB 128, Indian Rocks Beach, FL 33535, (813) 595-7890. Circle 598 on inquiry card.



### Compatibility Guide

Nashua Corporation's new pocket-sized Compatibility Guide contains a complete list of all disk drives in use and the Nashua Corporation disk products developed for each. The guide provides a description of the disk pack and cartridge charac-

teristics, a comparison table, and an illustration of a disk layout.

The Compatibility Guide is available from Nashua Corporation, Computer Products Division, 44 Franklin St., Nashua, NH 03061. ■ Circle 600 on inquiry card.

### Trade-A-Computer

Trade-A-Computer is a monthly classified magazine dedicated to selling, buying, and trading new and used computer products. Trade-A-Computer has an online data-entry service called Ad-Line, a 300-bit-per-second software system that asks a series of questions concerning your ad, then composes the ad after completing its inquiry. There are no additional charges for this service.

Classified ads cost \$1 per line; display ad rates are available. Ad-Line can be accessed by calling (215) 462-4415. Subscriptions cost \$10 per year. Contact Trade-A-Computer, POB 15842, Philadelphia, PA 19103, (215) 462-4416.

Circle 599 on inquiry card.

### Where Do New Products Items Come From?

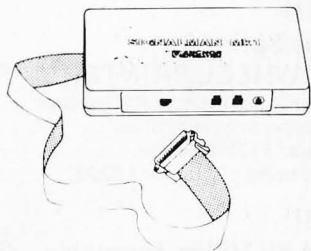
The information printed in the new products pages of BYTE is obtained from "new product" or "press release" copy sent by the promoters of new products. If in our judgment the information might be of interest to the personal computing experimenters and homebrewers who read BYTE, we print it in some form. We openly solicit releases and photos from manufacturers and suppliers to this marketplace. The information is printed more or less as a first-in first-out queue, subject to occasional priority modifications. While we would not knowingly print untrue or inaccurate data, or data from unreliable companies, our capacity to evaluate the products and companies appearing in the "What's New?" feature is necessarily limited. We therefore cannot be responsible for product quality or company performance.



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6522 VIA	6.45	10/6.10	50/5.75	100/5.45
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 DIRECT CONNECT Modem with RS232 Cable and Connector included. Fully compatible with all Bell 103 modems. 0 to 300 bps, full duplex, frequency shift keyed modulation, automatic ANSW/ORIG selection, direct connect, audible tone carrier detect indicator, self-contained battery powered.

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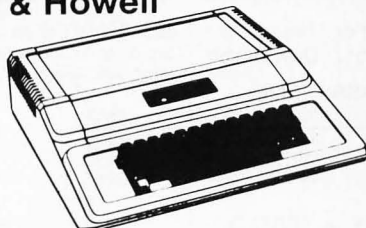
For Commodore Computers, the Signalman Mk1P includes connector, cable, and machine language software (parallel port).

## STAR MODEM

Prentice/Livermore Data Systems

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Library of PET Subroutines	17

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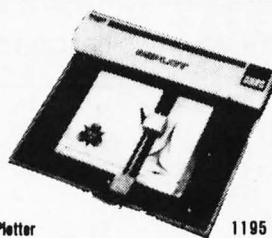
Adds extra RAM which can be write protected like ROM.

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**EPROM Programmer for CBM/PET 79**

Branding Iron with software/hardware for 2716 and 2532.

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High output, low noise, 5 screw housings.

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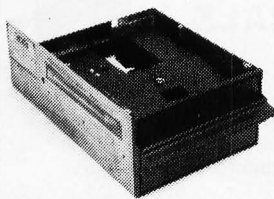
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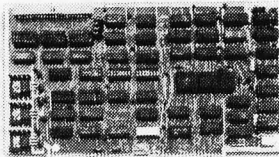
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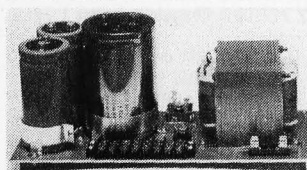
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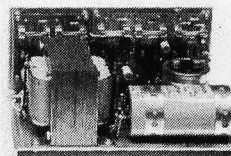
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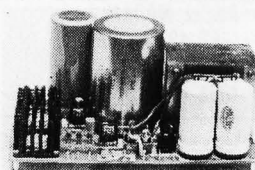
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CRT CONTROLLER	6522 APPLE II INTERFACE	81-260 "SLIM"	JBE I MICROCOMPUTER
 <p>This intelligent CRT Controller uses an 8085A CPU &amp; an 8275 Integrated CRT Controller. It features:</p> <ul style="list-style-type: none"> <li>• 25 lines (80 char./line)</li> <li>• 5x7 dot matrix</li> <li>• Upper &amp; lower case</li> <li>• Two 2716's (controller &amp; char. generator)</li> <li>• Serial interface RS232 &amp; TTL</li> <li>• Baud rates of 110, 150, 300, 600, 1200, 2400, 4800 and 9600</li> <li>• Keyboard scanning system</li> <li>• Unencoded keyboard required</li> <li>• Uses +5V &amp; ±12V Power Supplies</li> <li>• Does not have graphic capabilities.</li> </ul> <p>Documentation includes program listing and composite video circuit.</p> <p>Bare Board only (with doc) <b>\$39.95</b> 2716 Char. Gen. A7 <b>\$19.95</b> 2716 Program A12 <b>\$19.95</b></p>	 <p>The JBE 6522 Parallel Interface for the Apple II Computer, plugs directly into any slot 1 through 7 in the Apple. This card has 2 6522 VIA's that provide:</p> <ul style="list-style-type: none"> <li>• Four 8 bit bi-directional I/O ports</li> <li>• Four 16 bit programmable timer/counters</li> <li>• Serial shift registers</li> <li>• Handshaking</li> </ul> <p>A 74LS05 is for timing. Four 16 pin sockets provide easy connections to other peripheral devices. (Dip jumpers with ribbon cables are also available from JBE) The 6522 Parallel I/O card interfaces to the JBE EPROM programmer.</p> <p>Understanding of machine language required to use this board. Inputs and outputs are TTL compatible.</p> <p>79-295A <b>\$69.95</b> Assembled 79-295K <b>\$59.95</b> Kit 79-295B <b>\$19.95</b> Bareboard</p>	 <p>Single board large scale Integration Microcomputer. This 4.5 x 6.5 board uses the 6502 Microprocessor, two 6522 VIA's, four 2114 RAM's, 2516, 2716 or 2532 EPROM. The fully buffered 22/44 pin bus is similar to the KIM®, SYM®, and AIM® expansion connector. The four 8 bit I/O ports connect through 16 pin dip sockets. This board was designed for control and is ideal for Personal and OEM use.</p> <ul style="list-style-type: none"> <li>• 6502 MPU</li> <li>• Two 6522 VIA's</li> <li>• Four 2114 RAM's (2K bytes)</li> <li>• One EPROM 2516 or 2532</li> <li>• Crystal clock 1 Mhz</li> <li>• Requires 5V 1AMP Power</li> <li>• 4.5 x 6.5 card</li> <li>• Power on reset</li> <li>• Fully buffered-expandable</li> <li>• Solder mask-both sides</li> </ul> <p>Use your Apple II Computer, JBE 6522 Parallel Interface card and EPROM Programmer as a development system for SLIM.</p> <p>Prices: 81-260A <b>\$199.95</b> Assembled 81-260K <b>\$149.95</b> Kit 81-260B <b>\$ 39.95</b> Bare Board</p>	 <p>JBE's 7.75 x 11.75 6502 base Microcomputer has the capacity for 16K of EPROM, 4K of RAM, 8 Parallel Ports and 1 Serial Port. Monitor and Tiny Basic are also available. The fully populated version includes:</p> <ul style="list-style-type: none"> <li>• 1 6502 CPU</li> <li>• 4 6522 VIA (8 Parallel I/O Ports)</li> <li>• 1 AY5-1013 (Serial I/O Ports)</li> <li>• 8 2114 RAM (4K)</li> <li>• 2 2716 EPROM (Monitor &amp; Tiny Basic)</li> </ul> <p>The partially populated version includes:</p> <ul style="list-style-type: none"> <li>• 1 6502 CPU</li> <li>• 1 6522 VIA (2 Parallel I/O Ports)</li> <li>• 1 AY5-1013 (Serial I/O Port)</li> <li>• 2 2114 RAM (1K)</li> <li>• 1 2716 EPROM (with Monitor)</li> </ul> <p>Both versions include sockets for 2716s or 2532s, 8 16 pin sockets for I/O interfacing and a DB25 connector for RS232.</p> <p>All address and data lines are brought off the board to the 50 pin edge connector. (similar to the Apple II bus)</p> <p>This board also features power on reset and cassette interface.</p> <p>81-030 C Fully Populated <b>\$349.95</b> 81-030M Partially Populated <b>\$249.95</b> 81-030B Bare Board <b>\$ 89.95</b> 2716 EPROM (with Monitor) <b>\$ 19.95</b> 2715 EPROM (with Tiny Basic) <b>\$ 19.95</b></p>
A-D CONVERTER	SPEECH SYNTHESIZERS	6502 MICROCOMPUTER	
 <p>JBE's 16 channel A-D Converter plugs into your Apple II computer. It uses an ADC0817 which incorporates a 16 channel multiplexer and an 8 bit A-D Converter. The 16 inputs are high impedance and the voltage range is 0 to 5.12 volts. Conversion time is &lt;100µsec. The resolution is 8 bits or 256 steps, linearity is ± 1/2 step. Two 16 pin DIP sockets are used for input, GND &amp; reference voltage connections. There are 3 single bit TTL inputs. Doc. Includes sample program.</p> <p>81-132A Assm. <b>\$89.95</b> 81-132K Kit <b>\$69.95</b> 81-132B Bare Board <b>\$29.95</b></p>	 <p>JBE's Speech Synthesizers use the Votrax SC-01 Phoneme Synthesizer chip. The SC-01 phonetically synthesizes continuous speech of unlimited vocabulary. The SC-01 contains 64 different phonemes and 4 levels of inflection accessed by an 8 bit code. It requires 10 Bytes per second for continuous speech. Both boards have an audio amp for direct connection to an 8 ohm speaker.</p> <p>Documentation includes basic user programs, a phoneme chart and listing of coded words to help you get started. Documentation for the Apple II® Speech Synthesizer includes a disk with many user programs.</p> <p>81-088 Apple II Speech Synthesizer <b>\$139.95</b> 81-120 Parallel Input Speech Synthesizer <b>\$149.95</b> Prices include the SC-01 Chip SC-01 sold separately for <b>\$ 75.95</b></p>	 <p>6502 MPU, 6522 VIA, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 400 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 1 Mhz clock.</p> <p>Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.</p> <p>80-153 Assm. <b>\$110.95</b> 80-153 Kit <b>\$ 89.95</b> 80-153 Bare Board <b>\$ 19.95</b></p>	
EPROM PROGRAMMER	EPROM EXPANSION CARD	Z-80 MICROCOMPUTER	
 <p>JBE's EPROM Programmer is designed to program 5V 2516's, 2532's &amp; 2716's. It interfaces to the JBE Parallel I/O card using four ribbon cables. An LED indicates when the EPROM is being programmed. A textool zero insertion force socket is used for the EPROM. Comes with complete documentation for writing and reading EPROM's in the Apple II or Apple II Plus. Cables available separately.</p> <p>80-244A Assm. <b>\$49.95</b> 80-244K Kit <b>\$39.95</b> 80-244B Bare Board <b>\$24.95</b></p>	 <p>JBE EPROM Expander for the Apple II holds six 5V 2716s for a total of 12K bytes of EPROM. This board takes the place of the on board ROM in the Apple. It is software switchable by the same technique used by the Apple II firmware card. Solder jumpers are for reset to the Apple ROM or EPROM Expansion Card. Use JBE EPROM Programmer and Parallel I/O to program your EPROMs. EPROMs sold separately.</p> <p>81-085A Assm. <b>\$59.95</b> 81-085K Kit <b>\$49.95</b> 81-085B Bare Board <b>\$39.95</b></p>	 <p>Z-80 MPU, Z-80 PIO, 2716 EPROM, 2114 RAM single board computer. Single 5 volt power supply at 300 Ma. Two independent 8 bit I/O ports with handshake lines. RC controlled 2Mhz clock.</p> <p>Complete documentation. I/O lines use 50 pin edge connector. Data and address lines are not accessible. Mod. for 2532 is included. EPROM is not included. 1K RAM, 2K EPROM, 2 I/O ports.</p> <p>80-280 Assm. <b>\$129.95</b> 80-280 Kit <b>\$119.95</b> 80-280 Bare Board <b>\$ 19.95</b></p>	
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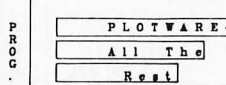
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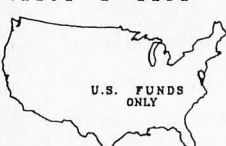
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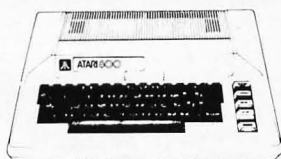
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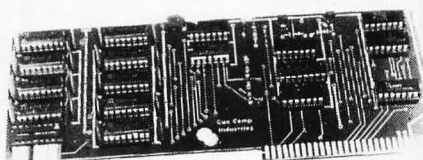
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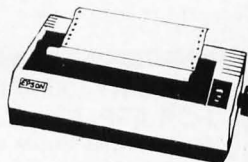
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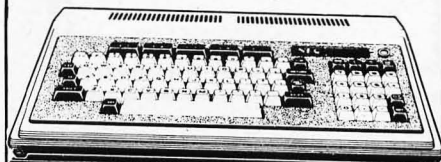
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4.440B	6.867B	10.854B	18.000B	34.437B	40.777B	43.333B
4.550B	6.7584B	10.8250B	18.1958B	34.555B	40.8125B	43.370B
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4.750B	7.0916B	10.850B	19.750B	35.788B	40.875B	43.444B
4.9152B	7.1590B	11.000B	20.000B	35.873B	40.888B	43.518B
4.9562B	7.183B	11.136B	20.480B	35.875B	40.926B	43.550B
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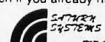
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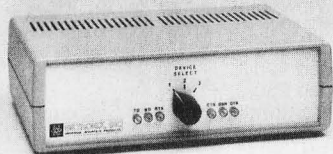
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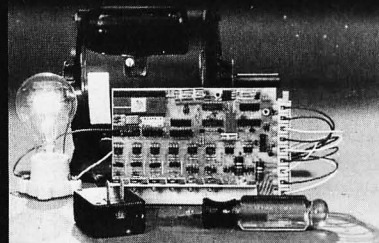
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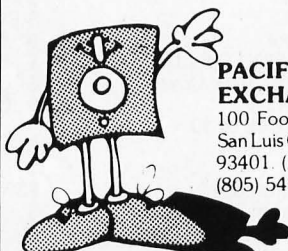
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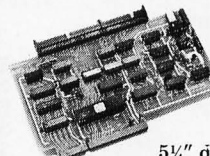


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74LS26	30	74LS160	90	74LS348	1.95	4020	95	4066	75	4526	1.25
74LS27	35	74LS161	90	74LS352	1.50	4021	95	4068	40	4527	1.75
74LS28	35	74LS162	90	74LS353	1.50	4022	95	4069	40	4528	1.25
74LS30	25	74LS163	90	74LS363	1.35	4023	35	4070	40	4531	95
74LS32	55	74LS164	90	74LS366	90	4024	35	4071	30	4532	1.75
74LS33	55	74LS165	90	74LS369	90	4025	35	4072	30	4539	1.75
74LS37	50	74LS166	2.00	74LS367	65	4026	1.95	4073	30	4543	1.95
74LS38	35	74LS168	1.70	74LS368	65	4027	65	4075	30	4553	4.95
74LS40	25	74LS169	1.70	74LS373	1.15	4028	80	4076	95	4555	95
74LS42	50	74LS170	1.70	74LS374	1.75	4029	95	4078	50	4556	95
74LS47	75	74LS173	75	74LS375	65	4030	45	4081	40	4558	2.25
74LS48	75	74LS174	90	74LS377	1.40	4031	1.50	4082	40	4568	5.95
74LS49	75	74LS175	90	74LS385	1.85	4032	2.75	4085	95	4581	1.95
74LS51	25	74LS181	2.10	74LS386	60	4033	2.75	4086	95	4582	1.95
74LS54	35	74LS184	95	74LS387	1.85	4034	2.75	4088	95	4584	95
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74LS85	1.10	74LS221	1.15	74LS641	3.00	7812CT	85	LM308V	75	LM723	50
74LS86	40	74LS240	1.15	74LS642	3.00	7815CT	95	LM309K	1.50	LM733	95
74LS90	60	74LS241	1.15	74LS645	3.00			LM311V	60	LM741V	30
74LS91	80	74LS242	1.85	74LS668	1.65			LM317T	1.90	LM747	75
74LS92	65	74LS243	1.85	74LS669	1.65	7806KT	1.40	LM317K	3.75	LM748V	60
74LS93	60	74LS244	1.00	74LS670	2.15	7812KT	1.40	LM318	1.50	LM1414	1.50
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74LS113	40	74LS253	80	74LS688	2.35	7915CT	1.15	LM380	1.25	LM3909	90
74LS114	50	74LS257	80	74LS689	2.35			LM386V	1.25	LM3914	3.75
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74S03	45	74S134	65	74S240	3.95	74C04	35	74C163	1.95	74C910	9.90
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74S05	75	74S138	1.05	74S251	1.85	74C10	35	74C165	1.95	74C912	9.90
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74S40	40	74S174	1.05	74S373	3.40	74C86	90	74C244	2.20	74C928	7.90
74S51	75	74S175	1.05	74S374	3.40	74C89	4.50	74C373	2.70	74C929	7.90
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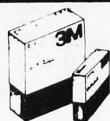
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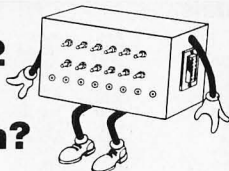
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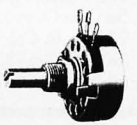


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

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The JE305 Solar Cell Panel Kit contains 20 ea. solar cells. On the panel board are power line taps which allow the user to select voltages (1 voltage at a time) from 0.5VDC to 10VDC. The applications of each panel can be further expanded by coupling additional panels in series for more voltage or in parallel for more current. The premium grade solar cells provide the current necessary for the operation of most portable transistor radios, small battery powered cassette tape players & unlimited experimental solar projects.

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74LS10.	.55	74LS154	1.95
74LS14.	1.09	74LS157	1.19
74LS30.	.55	74LS161	1.29
74LS32.	.69	74LS174	1.19
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74LS42.	1.29	74LS192	1.49
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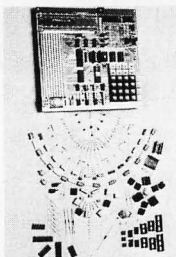
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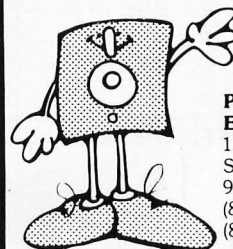
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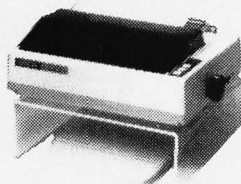
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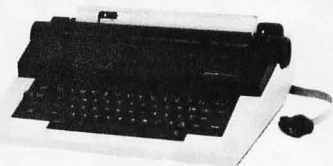
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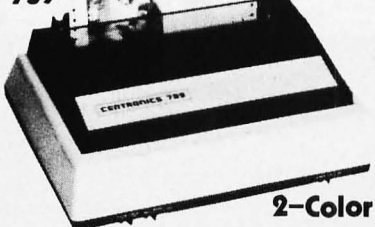
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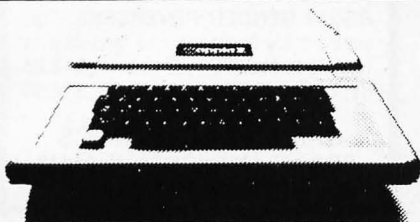


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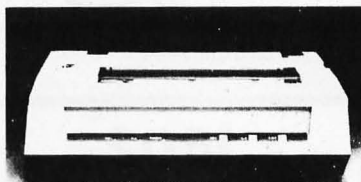
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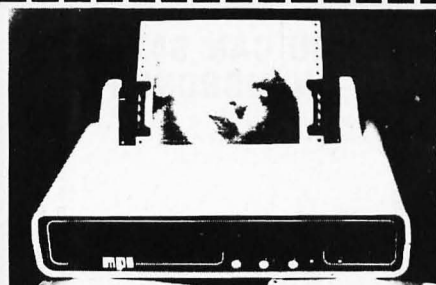


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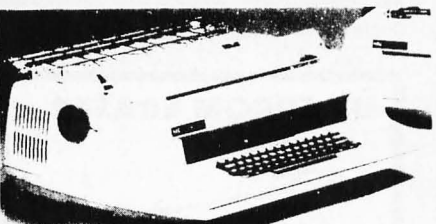
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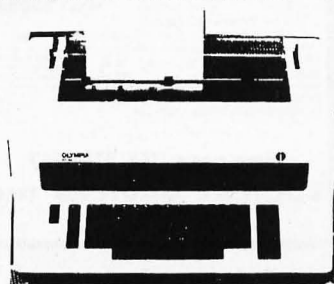
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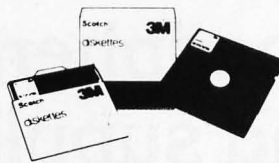
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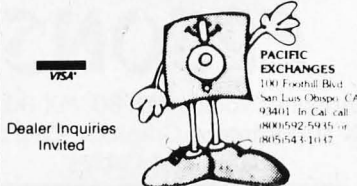
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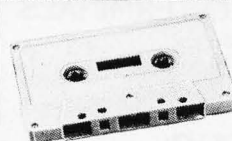
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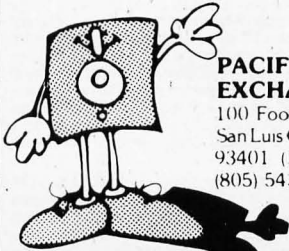
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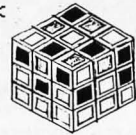
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① **FREE DECODER PLANS** plus a brochure describing our new UHF-VHF Conversion Kit are yours just by sending us your name, address and a 20¢ stamp.

② **UHF-VHF CONVERSION KIT.** Complete with PC board; all required components; jumper wire; cabinet with speaker; and comprehensive brochure incl. schematic, board layout, mounting and hook-up diagrams, parts list, and assembly and set-up instructions. All parts are industrial prime quality.

③ **9-INCH BLACK AND WHITE CRT MONITOR.** Ideal for microcomputer or security use. 22 transistors. Designed for excellent resolution. Frequency response — 12 MHz. Continuous DC restoration for superior contrast.

List Price \$225.00 each.

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Our  
Own  
Famous  
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**\$11995.00**

Our  
Factory  
Direct  
Price

**\$16500.00**

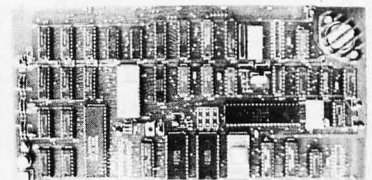
**SCR ELECTRONICS INC.**  
9533 Valley View Street, Cypress, CA 90630

Pay by CHECK, M.O., VISA, M/C, C.O.D.  
For Free Buyers Guide Circle Number Shown Below

Circle 349 on inquiry card.

## NEW! S-100 BUS COMPATIBLE

**SINGLE BOARD COMPUTER WITH VIDEO OUTPUT**



### USES:

This card can function as a stand alone single board computer or a S-100 intelligent video interface card

### FEATURES:

Bare board with documentation...\$49.95  
4 MHz Z-80A\*, up to 8K of EPROM, up to 4K Static RAM, two 8 BIT input ports, one 8 BIT output port, one 8 BIT sense input port with interrupt, composite video output (80x24), video attributes (reverse video, underline, blink), graphics capabilities.

### PRICE:

Bare board with documentation...\$49.95  
Monitor and video terminal software (in EPROM)...\$45.00  
Source listings (with Monitor purchase)...\$15.00  
Hard to find Parts Kit (crystal and fuse link PROMs)...\$15.00

**EMS** Educational Microcomputer Systems  
P.O. BOX 16115 IRVINE, CA 92716-1115

Circle 146 on inquiry card.



# INCREDIBLE? BELIEVE IT!

## Washington Computer Services

an affiliate of **WASHINGTON ELECTRIC COMPANY** est. 1912

CUSTOM COMPUTER ROOM WIRING SINCE 1960

97 Spring Street, New York, New York 10012

TELEX #12-5606

TO ORDER: CALL OUR TOLL-FREE NUMBER: (800) 221-5416 In N.Y. State and for technical information: (212) 226-2121

HOURS: 9 AM-5:30 PM (EST) Monday-Friday

### PRINTERS



150 cps bidirectional - 9x9 dot matrix, quietized case, 136 col, vertical form control and many other functions

**\$1195**

We feel this printer offers the best price/performance ratio available.

RS-232 serial to 19,200 baud x-on, x-off add \$40

NOVELL 800



Teletype 40, 300 LPM-typewriter quality, RS-232 interface. This quality printer is available in many configurations including forms access, quietized case, etc.

**SCALL**

from Only

**\$2928**

Teletype 43

Teletype AP-200, 340 cps dot matrix (similar to Data Prod. M-200)

from \$995

**\$2799**

NEC Spinwriter-55 cps, bidirectional, letter quality

R.O. 7710

**\$2560**

KSR 7720

**\$2799**

DIABLO 630-40 cps, bidirectional, daisy wheel, plot/graph

**\$2349**

QUME Sprint 9/45 cps, daisy wheel

**\$2228**

C. ITOH Starwriter, 25 cps, daisy wheel

**\$1575**

C. ITOH Starwriter, 45 cps, daisy wheel

**\$1725**

EPSON MX-80, 100, 80 cps, 9x9 dot matrix

**SCALL**

ANADIX 9500/9501, up to 200 cps, high resolution dot

**\$1325**

OKIDATA Microline 80, 80 cps, 9x7 dot matrix

**\$399**

Microline 82A, bidirectional, friction/pin feed

**\$525**

Microline 83A, bidirectional, 120 cps, uses 15" paper

**\$799**

TI-810, 150 cps, Basic

**\$1449**

Package-Compressed print, vertical form control

MANNESMANN MT 1705 200 cps, 7x9, 132 col

**\$1630**

TALLY MT 1805 200 cps, 7x9 + NLQ 40x18 matrix

**SCALL**

CENTRONICS 704-9, 180 cps, 9x9 dot matrix, 132 col

**SCALL**

739 100 cps, nx9 dot matrix, Full Graphics

**\$700**

DEC LA-34

**\$1085**

IDS 460G

**\$892**

### S-100 SPECIALTIES



68000 16 bit multi-user UNIX V.7

**SCALL**



8086 16 bit, 128K RAM, Syst. #2

**\$3499**

Systems Group

Call us for best prices on these high quality 2nd generation boards and systems.



These high quality, reliable products have made CCS defaulto industry standard for S-100 products

Assembled and tested:

2200 H.D. Mainframe, 20a. P.S., 12 slot MB

**\$434**

**\$359**

2065C 64K dynamic RAM/Bank Select

**\$720**

**\$580**

2810A Z-80 CPU, serial port, ROM monitor

**\$310**

**\$259**

2422A Floppy Cont, CP/M 2.2 ROM monitor

**\$425**

**\$345**

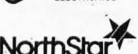
IMS 8000 SX, multi-user, multi-processor, turbo DOS

**SCALL**

INTERNATIONAL CPM 2.2. FULL 2 YEAR WARRANTY!



We offer generous discounts on the Compupro line of 1M, fast, quality 8 and 16 bit boards



ADVANTAGE & HORIZON

**SCALL**

Similar savings on the full lines of CCS, SSM, NNC, MORROW, DELTA, NORTHSTAR, ITHACA INTERSYSTEMS, GODBOUT, NEC, TELEVIDEO, IMS ZENITH, ADDS, DEC, DATA GEN., ATARI, DYNABYTE, TECMAR, DUAL

### 8" DISK DRIVE SALE

8" SHUGART SA801R \$450 8" SHUGART SA 851R \$669 2 for \$1289

QUME DATATRACK 8 \$589 2 for \$1110

VISTA Industrial grade enclosure for 2 drives with P.S. \$420

MORROW Discus 2D + CP/M MICROSOFT BASIC, CONT. \$950

Discus 2 + 2 + CP/M MICROSOFT BASIC, CONT. \$1195

Enclosure, power supply for 2 8" drives A & T \$350

### HARD DISK SPECIALS

CORVUS 10MB and controller \$5358 **SCALL**

20MB and controller \$6450 **SCALL**

Constellation Network Multiplexer and Mirror Video Tape Disk Backup

MORROW 26MB + controller + CP/M 2.2, M basic \$4495 **\$3821**

controller, CDC Hawk Drive (5 fix, 5 rem) \$7995 **\$6795**

controller, Western Dynex (5 fix, 5 rem) \$5995 **\$5099**

Winchester 5 1/4 drives complete with case, cable, software, S-100 controller. Adapter avail. for use with any Z-80 system. Cartridge drive controllers avail.

**List**

5MB APPLE \$2898

10MB XEROX \$3398

ALDOS S-100

OEM discounts available!

ADDS PRIAM 8" and 14" Winchester/tape subsystems avail.

WORDSTAR \$300

MBASIC 80 \$235

DBASE II \$525

SUPERCALC \$221

### FULLY CONFIGURED BUSINESS SYSTEMS

The following are some examples of the fully assembled and tested business

and scientific computer systems which we offer. All include 64K bytes

RAM, Z-80A, 4mh CPU. We offer a full line of quality, tested software.

InterSystems fine computers **SCALL**

Delta S-4500 10 User, Multi-Processor, 40 MB hard 17 MB tape **SCALL**

CC 2210A w/floppy controller, 1 serial port \$1849

CCS 300-1A w/1.2 MB floppy drives, 2 serial, 2 parallel ports \$4849

CCS 400-1A w/10 MB hard disc, 2 serial, 2 parallel ports \$6999

NNC 80W w/5MB floppy, 8.4 MB hard disc, (OASIS optional) \$6693

ALTOS single and multi-user systems **SCALL**

MORROW Decision 1, CP/M Microsoft Basic, UNIX **SCALL**

820 Desktop computer-64K, 2 floppys. (CP/M avail.)

XEROX List \$2995 **SCALL**

We offer multi-user networks by DELTA PRODUCTS, DISCOVERY, TELEVIDEO,

MUSYS, IMS, DIGITAL MICROSYSTEMS

TERMINALS PMMI MODEM \$359

AMPEX DIALOGUE 30, 80 **SCALL**

TELEVIDEO 910 C (multi-terminal) \$610

925C \$795

950C \$950

SOROC IQ 120 \$729

HAZELTINE ESPRIT \$669

DEC VT-100 \$1575

Similar savings for our HAZELTINE and LEAR SIEGLER lines

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Systems Houses, Educational Institutions, &  
Government Agencies Given Special Consideration

### AMPEX

Dialogue 80"



ALL OF OUR PERIPHERALS CAN BE CONFIGURED FOR RADIO SHACK® MODEL II

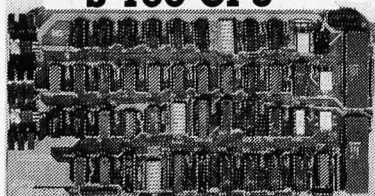
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For fast delivery, send certified check, money order or call to arrange direct bank wire transfer. Personal or company checks require two to three weeks to clear. All prices are mail order only. Prices subject to change without notice; call for latest prices. Prices include 3% cash discount. N.Y. residents add sales tax. Qantex is a trademark of North Atlantic Industries, Inc. Radio Shack® is a trademark of the Tandy Corp. CP/M® is a trademark of Digital Research. All sales subject to our standard sale conditions (available on request).





## S-100 CPU



### CPU-Z - GODBOUT

2/4 MHZ Z80 CPU 24 Bit Addressing

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
BCGBT160A	A & T	\$295.00	\$199.00
BCGBT160C	CSC 3-6 MHZ	\$395.00	\$375.00

### DUAL PROCESSOR 8085-8088 - GODBOUT

6 or 8 MZ Provides true 16 Bit Power with a standard 8 bit S-100 bus.

BCGBT1612A	A & T 6 MHZ	\$425.00	\$399.00
BCGBT1612C	CSC 6/8 MHZ	\$525.00	\$498.00

### SOLID STATE DISK DRIVE, 3500% FASTER!

Not Really, But the Next Best Thing For Godbout 8085/88 Users. Call for Details on M-Drive. See Page 340 of November **BYTE**

BCGBT MD 128K		\$1,550.00	
BCGBT MD 256K		\$3,000.00	

### 2810 Z80 CPU-CA. COMP. SYST.

2/4 MHZ Z80A CPU with RS232C Serial I/O Port complete with Monitor PROM for 2422 Disk Controller

BCCS2810A	A & T	\$350.00	\$260.00
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### CB2 Z80 CPU - S.S.M.

2/4 MHZ will accept 2716, or 2732, or RAM RUN/STOP and single step switches

BCSSMCB2K	Kit	\$260.00	
BCSSMCB2A	A & T	\$344.00	\$310.00
BCSSMZ80M	SSM280 Monitor	\$89.00	

### CBIA 8080 CPU - S.S.M.

8080 CPU, 1K RAM, Holds 1 2708, 1 Bit parallel input port.

BCSSMCB1K	Kit	\$183.00	
BCSSMCB1A	A & T	\$252.00	\$225.00
BCSSM8080M	SM 8080 Monitor	\$59.00	

## S-100 I/O BOARDS

### SYSTEM SUPPORT 1 - GODBOUT

Serial port (software prog baud), 4K EPROM OR RAM provision, 15 levels of interrupt, real time clock, optional math processor

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
BCGBT162A	Assembled & Tested	\$399.00	\$360.00
BCGBT162C	CSC	\$495.00	\$460.00
BCGBT231	Math Chip	\$195.00	
BCGBT232	Math Chip	\$195.00	
BCGBT162AM1	A&T with 8231 Math Chip	\$555.00	
BCGBT162CM1	CSC with 8231 Math Chip	\$655.00	
BCGBT162AM2	A&T with 8232 Math Chip	\$555.00	
BCGBT162CM2	CSC with 8232 Math Chip	\$655.00	

### MPX CHANNEL BOARD - GODBOUT

I/O Multiplexer, using 8085A-2 CPU on board

BCGBT166A	A & T	\$495.00	\$450.00
BCGBT166C	CSC	\$595.00	\$550.00

### INTERFACER I - GODBOUT

Two Serial I/O

BCGBT133A	A & T	\$249.00	\$219.00
BCGBT133C	CSC	\$324.00	\$298.00

### INTERFACER II - GODBOUT

Three parallel, one serial I/O board

BCGBT150A	A & T	\$249.00	\$219.00
BCGBT150C	CSC	\$324.00	\$298.00

### INTERFACER III - GODBOUT

Eight channel multi-use serial I/O board

BCGBT1748A	A & T	\$699.00	\$629.00
BCGBT1748C	CSC 200 hr. Burn In	\$849.00	\$750.00

### INTERFACER 3 WITH 5 SERIAL PORTS

BCGBT1745A	A & T	\$599.00	\$559.00
BCGBT1745C	CSC 200 hr. Burn In	\$699.00	\$629.00

### MULTI I/O - MORROW DESIGNS

Three Serial, Two parallel

BCMDSMB3200	A & T	\$359.00	\$329.00
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### SWITCHBOARD - MORROW DESIGNS

Two serial I/O, four parallel I/O, one status port, one strobe port

BCMDSSB2411		\$299.00	\$269.00
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### I/O4 - SSM

Two serial I/O, two parallel I/O

BCSSM104K	Kit		\$210.00
BCSSM104A	A & T	\$290.00	\$260.00

### I/O 5 - SSM

2 Serial, 3 Parallel including 1 Centronics

BCSSM1051	A & T	\$329.00	\$309.00
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### I/O 8 - SSM

8 Port Serial I/O with Timer

BCSSM108A	A & T	\$550.00	\$495.00
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### 2710 4 PORT SERIAL - CCS

4 Full handshaking RS232 ports and optional 2K ROM

BCCS271001	A & T	\$360.00	\$310.00
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### 2718 2 SERIAL & 2 PARALLEL - CCS

2 RS232C ports, 2 8 bit parallel ports, & optional 2K ROM

BCCS271801	A & T	\$360.00	\$325.00
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### 2720 4 PORT PARALLEL - CCS

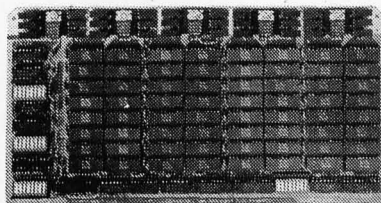
4 8 bit parallel ports and optional 2K ROM

BCCS272001	A & T	\$250.00	\$225.00
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## S-100 10 MHZ STATIC RAM

NEW LOW PRICES!

## RAM 20 - 32K SALE \$299.00



### 32K STATIC RAM - GODBOUT

RAM 20 10 MHZ, 4K byte block disable, bank select or 24 bit addressing available 8, 16, 24 or 32K

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
BCGBT164AA8	8K A&T	\$210.00	\$190.00
BCGBT164AC8	8K CSC	\$280.00	\$260.00
BCGBT164AA16	16K A&T	\$285.00	\$260.00
BCGBT164AC16	16K CSC	\$355.00	\$325.00
BCGBT164AA24	24K A&T	\$355.00	\$325.00
BCGBT164AC24	24K CSC	\$425.00	\$385.00
BCGBT164AA32	32K A&T	\$425.00	\$299.00
BCGBT164AC32	32K CSC	\$495.00	\$450.00

### CMOS STATIC RAM

For a complete analysis of the advantages of CMOS memory, see the "Product Description" on page 416 of the January Issue of **BYTE**.

### 64K CMOS STATIC RAM - GODBOUT

RAM 17, 10 MHZ, 2 Watt, DMA Compatible 24 Bit Addressing

BCGBT175A48	48K A&T	\$650.00	\$619.00
BCGBT175C48	48K CSC 200hr.	\$750.00	\$710.00
BCGBT175A64	64K A&T	\$795.00	\$755.00
BCGBT175C64	64K CSC 200hr.	\$895.00	\$850.00

### NEW! 32K x 16 BIT CMOS STATIC RAM - GODBOUT

RAM 16 10 MHZ, 32K x 16 or 64K x 8

IEEE/696 16 BIT 2 Watt, 24 Bit Addressing

BCGBT180A	64K A&T	\$895.00	\$850.00
BCGBT180C	64K CSC	\$995.00	\$945.00

### NEW! 128K NMOS STATIC RAM - GODBOUT

RAM 21 10MHZ 128K x 8 OR 64K x 16

IEEE/696 8 or 16 Bit 1.2 Amps 24 Bit Addressing

BCGBT167A	128K A&T	\$1695.00	\$1610.00
BCGBT167C	128K CSC	\$1895.00	\$1795.00

## S-100 PROM

### FBI PROM PROGRAMMER - SSM

Programs 2708 or 2716's, operates as a 4K/8K EPROM BOARD AS WELL.

BCSSMPB1K	Kit		\$179.00
BCSSMPB1A	A & T	\$265.00	\$220.00

### ECONOROM 2708 - GODBOUT

16K x 8 EPROM Board using 2708, Power on jump to any 256 byte

BCGBT125A	A & T	\$135.00	\$120.00
BCGBT125C	CSC	\$195.00	\$175.00

### MB8A - SSM

1K/16K 2708 EPROM board, disable in 1K increments

BCSSMMB8AK	Kit		\$114.00
BCSSMMB8AA	A & T	\$179.00	\$159.00

## S-100 VIDEO BOARDS

### SPECTRUM - GODBOUT

Color Graphics board with Parallel I/O

BCGBT144A	A & T	\$399.00	\$349.00
BCGBT144C	CSC	\$449.00	\$399.00
BCGBT2D	Sublogic Universal Graphics Interpreter Software		\$35.00

### VB - 3 S.S.M.

80 x 25 or 50 character video display Memory

Mapped, Parallel Keyboard port

BCSSMBK324	80 x 24 Kit	\$425.00	
BCSSMBK324A	80 x 24 A&T	\$499.00	\$440.00
BCSSMBK3UP	80 x 50 Line Upgrade	\$39.00	

### VB2-S.S.M.

I/O Mapped Video Board, with Parallel Keyboard port 64 x 16

BCSSMBK2K	Kit		\$199.00
BCSSMBK2A	A & T	\$269.00	\$229.00

### VBBB - S.S.M.

Memory Mapped Video Board 64 x 16 character

display or 64 x 16 graphics display

BCSSMBK1K	Kit		\$179.00
BCSSMBK1A	A & T	\$242.00	\$220.00

## S-100 MOTHERBOARDS - GODBOUT

Active termination, 6-12-20 slot

BCGBT153A	A&T 6 slot, 2 lbs	\$140.00	\$126.00
BCGBT153C	CSC 6 slot, 2 lbs.	\$190.00	\$175.00
BCGBT154A	A&T 12 slot, 3 lbs.	\$175.00	\$155.00
BCGBT154C	CSC 12 slot, 3 lbs.	\$240.00	\$220.00
BCGBT155A	A&T 20 slot, 4 lbs.	\$265.00	\$235.00
BCGBT155C	CSC 20 slot, 4 lbs.	\$340.00	\$310.00

## S-100 DYNAMIC RAM



### THE EXPANDABLE 1

### PRIORITY 1 ELECTRONICS

THE EXPANDABLE 1™ 64K Dynamic Ram board provides your S-100 system with 64K of reliable, high-speed dynamic RAM. Compatible with most of the major S-100 systems on the market, including those with front panels, it supports DMA operations and requires no Wait states with current microprocessors.

- User expandable from 16 to 64K
- Supports DMA
- Designed to IEEE proposed S-100 bus standards
- 2 or 4 MHz operation
- Operates with either an 8080 or Z-80 based S-100 system, providing processor-transparent refreshes with both
- Supports IMSA-type front panels
- Jumper-selectable Phantom input
- Uses Popular 4116 RAMS
- All ICs in sockets
- Any 16K block can be made bank-independent
- Fully buffered address and data lines
- Fail-safe refresh circuitry for extended Wait states
- Board configuration with reliable, easy-to-configure Berg jumpers

BCPRIEXP116	16K Assembled & Tested	\$299.00
BCPRIEXP132	32K Assembled & Tested	\$399.00
BCPRIEXP148	48K Assembled & Tested	\$379.00
BCPRIEXP164	64K Assembled & Tested	\$409.00

## S-100 DISK CONTROLLERS

### 2422A - CA. COMP. SYST.

I/O Mapped, controls 8", single or double density A&T with CPM 2.2 8" S.D.

	LIST PRICE	OUR PRICE
BCCCS2422A	\$475.00	\$375.00

### DISK JOCKEY 2D - MORROW

Memory Mapped, controls 8", single or double density, serial I/O

BCMDJ2208	A&T with CP/M 2.2	\$399.00	\$375.00
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## S-100 DISK SUBSYSTEMS

### DJ2B DISCUS SINGLE SIDED MORROW

8" DBL Density drives with cabinet, power supply controller, with CP/M 2.2 and Microsoft Basic

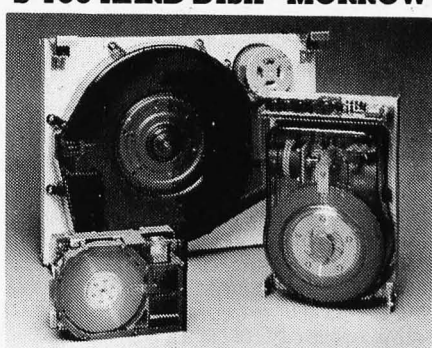
BCMDSF1218	Single Drive System	\$1095.00	\$950.00
BCMDSF1228	Dual Drive System	\$1875.00	\$1598.00

### DJ2B DISCUS DOUBLE SIDED - MORROW

8" DBL Density/sided drives with cabinet Power supply controller, with CP/M 2.2 and Microsoft Basic

BCMDSF2218	Single Drive System	\$1395.00	\$1250.00
BCMDSF2228	Dual Drive System	\$2495.00	\$2050.00

## S-100 HARD DISK - MORROW



5.25" 5MB, 8" 10 & 20MB, 14" 26MB formatted hard disk complete with cabinet, P.S., Controller, CP/M 2.2 and Microsoft MBASIC 80

	LIST PRICE	SALE PRICE
BCMOCMAMS	5 MB	\$2495.00
BCMDSM10S	10 MB	\$3695.00
BCMDSM20S	20 MB	\$4795.00
BCMDSM26S	26 MB	\$4495.00

## VIDEO MONITORS

### VM121 - ZENITH

15 MHz 12" P31 Green phosphor 40 or 80 characters per line

BCZVM121	20 lbs.	\$159.00	\$139.00
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### VM4509 - SANYO

10MHz, 9" 16 x 64 P4 B&W monitor

BCSYVM4509	15 lbs.	\$235.00	\$198.00
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### DM5012 - SANYO

18MHz, 12" 24 x 80 P4 B&W monitor

BCSYDM5012	24 lbs.	\$340.00	\$310.00
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### DM5112 - SANYO

18MHz, 12" 24 x 80 P31 Green on Black display

BCSYDM5112	24 lbs.	\$360.00	\$325.00
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### VM6013 - SANYO

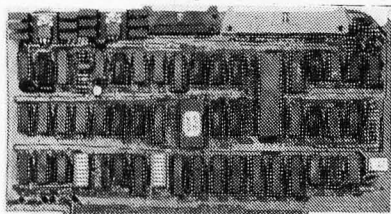
COLOR 13" 16 line x 64 character monitor

BCSYVM6013	35 lbs	\$550.00	\$495.00
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# PRIORITY ONE ELECTRONICS

## GODBOUT DMA DISK 1 WITH FREE CP/M 2.2 SALE \$450.00



### SAVE \$220.00

Priority 1 Electronics is pleased to offer the GODBOUT DISK 1 High Performance Disk Controller at our regular low price with CP/M 2.2 and BIOS at no additional cost. That's a savings of \$220.00 of the manufacturer's list price.

- Third generation INTEL 8272/NEC 765A LSI floppy disk controller.
- High speed cycle stealing DMA interface for processor independent data transfer between system memory and flexible disk.
- Handles up to four 8 or 5.25 inch floppy disk drives
- Single or double density/single or double sided capability.
- Supports IBM 3740 soft sector formats.
- 24 bit DMA addressing with data transfer across 64K boundaries for data transfer throughout the 16Mbyte memory map.

PART NO.	DESCRIPTION	LIST PRICE	OUR PRICE
BCPDB171ACPM	A&T w/CP/M 2.2 & BIOS	\$670.00	\$450.00
BCGBT171C	CSC	\$595.00	\$555.00
BCGBTCPMB0*	CP/M 2.2 for Z80/8085 with manuals & BIOS 8" S/D disk	\$175.00	
BCGBTOASBS	Oasis 8 bit single user 8" S/D disk	\$500.00	
BCGBTOASBM	Oasis 8 bit multiuser, 8" S/D disk	\$850.00	

## S-100 SYSTEMS

### SUPERSIXTEEN — GODBOUT

HERE IS WHAT EACH PACKAGE INCLUDES:

- BCGBT1612A 6 MHz 8085/8088 Dual Processor Board
  - BCGBT171A High Speed DMA Disk Controller
  - BCGBT162A System Support 1 Multi-Function Board
  - BCGBT133A Interfacer 1 Dual Serial I/O
  - BC128K 10MHz Low Power Static Ram
  - BCGBTCPMB 86 16 Bit Operating System Ready to Load & Go
- Cables and Documentation Three interfacar cables one disk I/O cable, complete documentor for all hardware, and manuals for both CP/M operating systems.

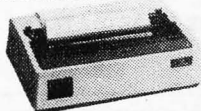
Compu Pro's famous 1 Year limited warranty.

Now to the best part of all. If purchased separately, these quality components would list for \$4,344.00. BUT SuperSixteen's low package price is an amazing \$3,495.00. You save \$849.00! (For boards qualified under the Certified System Component high-reliability program - with extended 2 year warranty, 200 hour burn-in and 8 MHz processors - add \$600.00 to the package price. Sh. Wt. 15 lbs.

BCPDB6BTJSJ	SuperSixteen A&T	\$3495.00
BCPDB6BTJSK	SuperSixteen CSC	\$4095.00

## PRINTERS

BEST  
PRICE!



## MICROLINE — OKIDATA

### WITH FRICTION AND TRACTOR FEED

- Bi-DIRECTIONAL - 120 CPS
- 9x9 Matrix (Alphanumeric)
- 6x9 or 12 Matrix for Graphics
- 5.8, 3, 10, 16 Characters per Inch
- 6 or 8 Lines per Inch
- 80 CPL @ 10 CPI for 82A
- 132 CPL @ 10 CPI for 83A
- Parallel and Serial I/O
- 100 Thru 1200 Baud
- Self Test
- Out of Paper Switch
- Friction or Tractor Feed
- 3" to 14" Top of Form (Switch Selectable)
- 10 Different Character Sets

PART NO.	DESCRIPTION	LIST PRICE	SALE PRICE
BCOKIDAT82AT(26 lbs)	80 CPL @ 10 CPI \$	\$799.00	\$539.00
BCOKIDAT83AT (37 lbs)	132 CPL @ 10 CPI	\$1195.00	\$750.00
BCOKISER2KBF	9600 baud with 2K Serial		\$159.00

Buffer upgrade with X-on Y-off High Resolution Graphics Prom \$99.00

CALL FOR THE NEW MICROLINE 84

## MX80 — EPSON

### NEED WE SAY MORE?

BCPEPMX80	Tractor Feed 17 lbs	\$645.00	\$450.00
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### PRINTER INTERFACES - MICROBYTE

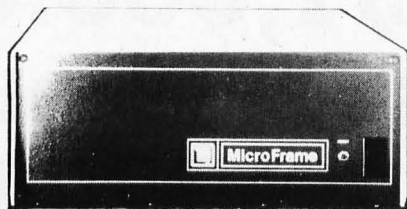
BCMBSEI1	RS232 Serial Conversion for MX80 A & T	\$55.00
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Apple Centronics 8 bit parallel interface for Centronics, Epson & OKIDATA printers

BCMBSEI1	A & T	\$55.00
BCMBSEI1	Cable for above	\$14.95

Printer interfaces & cables sold only with printer purchase

## S-100 MAINFRAMES



### S-100 MICROFRAME - TEI

110V 60HZ CVT Mainframes, the best money can buy!  
12 Slot  $\pm 8V$  17A  $\pm 16V$  @ 2A  
22 Slot  $\pm 8V$  @ 30A  $\pm 16V$  @ 4A

PART NO.	DESCRIPTION	LIST PRICE	1-9	10-24
BCTEIMCS 112	12 Slot Desk	\$685.00	\$615.00	\$570.00
BCTEIMCS 122	22 Slot Desk	\$825.00	\$760.00	\$705.00
BCTEIRM 12	12 Slot Rackmount	\$725.00	\$720.00	\$619.00
BCTEIRM 22	22 Slot Rackmount	\$875.00	\$850.00	\$750.00

Shipping Weight: On 12 Slot Mainframe 45 lbs.  
On 22 Slot Mainframes 55 lbs.

### TEI S-100 FRAMES

#### 3 - 5" DISK CUTOUTS

$\pm 8V$  @ 17 $\pm 16V$  @ 1.2A, Internal Cables

PART NO.	DESCRIPTION	LIST PRICE	1-9	10-24
BCTEITF12	12 Slot desk	\$675.00	\$625.00	\$580.00
BCTEIRF12	12 Slot Rackmount	\$795.00	\$715.00	\$665.00

Shipping Weight: On 12 Slot Desk 40 lbs.  
On 12 Slot Rackmount 45 lbs.

### DUAL 8" DISK DRIVE CHASSIS - TEI

For Shugart 800/801R or 850/851R with internal power cables provided  
+24V @ 1.5A +5V @ 1.0A - 5V @ .25A

PART NO.	DESCRIPTION	LIST PRICE	1-9	10-24
BCTEBCFD0	Desk Top	\$535.00	\$485.00	\$455.00
BCTEIRFD0	Rack Mount	\$720.00	\$670.00	\$630.00
BCPDBDFD0S1	DFDO with 1 Shugart 801R			\$597.00
BCPDBDFD0S2	DFDO with 2 Shugart 801Rs			\$1375.00
BCPDBRFD0S1	RFDO with 1 Shugart 801R			\$1095.00
BCPDBRFD0S2	RFDO with 2 Shugart 801Rs			\$1495.00
BCPRI50P6CE2	Internal Data Cable .50 pin plug connector to 2 Card Edge			\$34.95

Due to UPS shipping regulations, disk drives will be shipped separately from the cabinet. Don't forget to include shipping for each drive. (Shipping Weight, 16 lbs each.)

CALL FOR NEW TEI PRICES MARCH 1st

### S-100 MAINFRAME - GODBOUT

110V 60HZ CVT Mainframe uses famous 20 slot GODBOUT Motherboard. 55 lbs.  
BCGBTEMC20RM 20 Slot Rack Mount \$895.00 \$825.00  
BCGBTEMC20DK 20 Slot Desk Top \$825.00 \$760.00

### S-100 MAINFRAME - CCS

12-slot motherboard with removable termination card  
BCCCS220001 Office Cream 35 lbs \$575.00 \$535.00  
BCCCS220002 Blue 35 lbs \$575.00 \$535.00

### SOFTWARE - MICROPRO

All software is supplied on 8" Single Density IBM 3740 CP/M Compatible Diskettes

#### WORDSTAR

Screen-Oriented, integrated word processing system specifically designed for non-technical personnel  
BCMPRWDRSTAI \$495.00 \$300.00

#### MAIL MERGE WORD STAR OPTION

Powerful file merging tool  
BCMPRMLMRGAI (Requires Word Star 2.1 or later) \$250.00 \$100.00

#### SPELLSTAR WORD STAR OPTION

One Step "Proofreader" with compressed 20,000 word dictionary and user-created supplemental dictionaries  
BCMPRSPLSAI (Requires Word Star 3.0 or later) \$250.00 \$150.00

#### SUPERSORT

Sophisticated program that will select and re-arrange variable length information from data files  
BCMPSPRSRAI \$250.00 \$150.00

#### CALC STAR

Sophisticated, easy-to-use, electronic spread sheet and financial planner  
BCMPRCLGSTAI \$295.00 \$200.00

#### DATA STAR

Office-Oriented Data Entry, retrieval, and updating system  
BCMPDRATSTAI \$350.00 \$200.00



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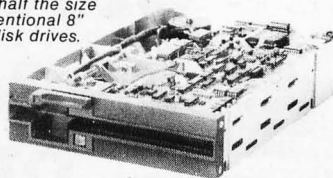
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## FLOPPY DISC DRIVES

Tandon TM-800 Thinline is exactly half the size of conventional 8" floppy disk drives.



Exactly one-half the height of any other model. Proprietary, high-resolution, read-write heads patented by Tandon D.C. only operation - no A.C. required Industry standard interface.

Three millisecond track-to-track access time 9 lbs.  
BCTNDTM8481 Single Sided \$495.00 2 or more \$470.00  
BCTNDTM8482 Double Sided \$625.00 2 or more \$600.00  
BCTNDTM8M Manual - not included with drive \$10.00

### 801R - SHUGART

Single sided double density most popular 8" drive  
BCSHU801R \$425.00 ea or 2 or more (16 lbs) for \$395.00 ea.  
BCSHU8A01RM Manual for 801R drives \$10.00

### DT-8 - QUME

2 OR  
MORE  
\$499.00

Data track 8 double sided, double density 8" Sh. Wt. 16 lbs \$525.00 ea.

BCQMEDT8

2 or more \$499.00 each

BCQMEDT8M Manual for DT-8 \$10.00

### 5 1/4" DRIVES - TANDON

Single Sided, 250KB (5 lbs) \$310.00  
Double Sided, 500KB \$370.00  
Single Sided, 500KB \$375.00  
Double Sided, 1000KB \$495.00  
BCTNDTM1001  
BCTNDTM1002  
BCTNDTM1003  
BCTNDTM1004  
BCTNDTM5M Manual, not included with drive \$10.00

### DISK CABINETS



### V-100 - VISTA

- Desk or rack mountable • Internal power and data cables
- Drives pull out for easy service and maintenance

BCVISV100 Disk Drive Cabinet (43 lbs) \$495.00 \$449.00

### SINGLE 8" - Q.T.

Single 8" cabinet with power supply (22 lbs) \$249.00 \$225.00

BCQTCDDC8

### DUAL 8" - Q.T.

Dual 8" cabinet with power supply (24) \$395.00 \$349.00

BCQTCDDC88

### 5" CABINETS - VISTA

Single 5" with P.S. \$75.00  
Dual 5" with P.S. \$95.00

BCVIS 9801  
BCVIS 9802

### TERMINALS



### VT200 — VISUAL TECHNOLOGY

THE MOST RELIABLE TERMINAL WE'VE EVER USED!

Detachable keyboard, RS232C or 20MA interface, 110 to 19200 baud, 12" non glare 80 x 24 display, RS232 Aux. port and composite video out.

BCVSL200 Shipping Weight 55 lbs. \$995.00

### VIEWPOINT — ADDS

Detachable keyboard, RS232 interface and auxiliary port, 80 x 24 display, tilt/able screen

BCADDVWPR Shipping Weight 40 lbs SALE \$599.00





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# SAVE \$1,000.00 ON



California Computer Systems

## 2.4 MEGA-BYTE S-100 DUAL 8" DISK COMPUTER SYSTEM

### HERE'S WHAT YOU GET:

#### 2210 MICROCOMPUTER SYSTEM

- 2 or 4 MHZ operation
- Z-80 CPU
- 65,536 bytes of dynamic RAM
- RS-232-C serial port
- Accepts 8" and 5 1/4" floppy disk drives
- 12-slot, cream colored mainframe
- Internal cabling installed
- CP/M 2.2 (on diskette) Operating System

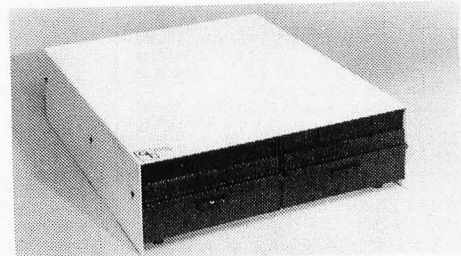
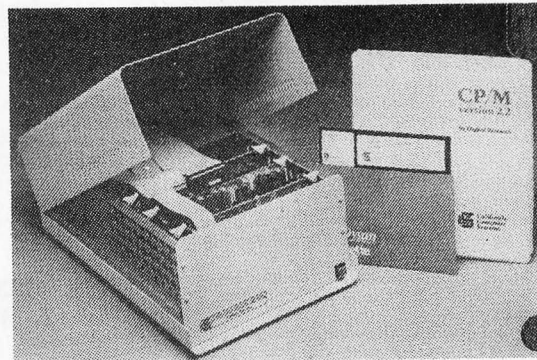
The Model 2210 Computer System is a Z-80 based system containing 65,536 bytes of dynamic RAM memory and floppy disk controller mounted in a 12 slot mainframe. The system is ideally suited for applications where user defined peripheral devices are to be used and a high degree of system flexibility and expandability is desirable.

The system components are the Models 2810 CPU, 2065 64K Byte Memory Module, 2422 Floppy Disk Controller and 2200 Mainframe. Also included in the system are internal cables interconnecting the DPU serial channel, disk controller 8" disk channel and disk controller 5 1/4" disk channel to the mainframe back panel. This permits connecting user peripherals directly to the system without the need of opening the mainframe.

Of the 12 slots available in the mainframe, only three are used for the basic system components. 9 slots are available for user options or other CCS products such as memory (expandable up to 512K bytes (serial and parallel I/O boards).

System software is provided using the CCS version of the CP/M Operating System, Version 2.2. The system is totally linked to permit auto-boot start-up with the CP/M on diskette.

The system is completely integrated and tested prior to shipment from CCS to assure proper configuration and system integrity.



BCCCS221001

\$2350.00

We add two REMEX 4000 Double Density, Double Sided 3ms 8" drives and a QTCDDC88 Dual 8" disk enclosure with power supply data cable and documentation

SALE  
PRICE

\$2930.00

This is a complete system,  
just add a terminal

ORDER PART NO BCPDBCCSSA  
INCLUDE \$30.00 FOR SHIPPING

IF THAT'S NOT A GOOD ENOUGH DEAL FOR YOU, WE WILL SELL YOU THE BCOKIDAT82AT FOR \$475.00 OR THE BCOKIDAT83AT FOR \$700.00 WHEN YOU BUY THIS SYSTEM AT THE SAME TIME!

## DIRECT CONNECT MODEM PRICE BREAKTHROUGH!

### THE SIGNALMAN MK 1

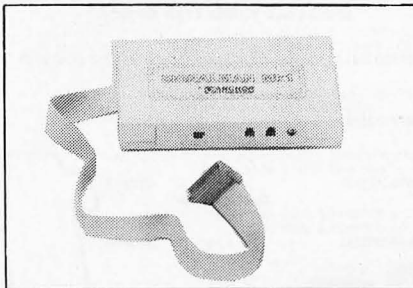
Meet the direct-connect SIGNALMAN MK1 ... the smallest, lightest, most compact modem available today. Its long life 9 volt self-contained battery and exclusive audible Carrier Detect Signal allows you to install the SIGNALMAN anywhere ... out of the way, and out of sight. Now, there is no need for messy cables, and no need to look at an LED to verify carrier.

Anchor's SIGNALMAN has been designed for transmitting both voice and data signals over all common telephone lines. And when you're in the data position, your SIGNALMAN automatically changes from ORIGINATE to ANSWER and back again as the need arises — ending all that confusion. Your SIGNALMAN is fully compatible with all BELL 103 modems — putting your computer in instant communications with thousands of other computers.

Anchor Automation has taken the FUSS out of communications. For business or fun, SIGNALMAN is the ideal modem.

#### PRODUCT FEATURES

- Direct Connect Modem
- Built-in RS232C Cable and Connector
- Self-contained 9V Battery — Wall plug transformer available.
- Audible carrier detect signal
- Automatic mode selection
- Talk/Data switch
- CONNECTS IN SERIES WITH MODULAR HANDSET JACK ON TELEPHONE
- Complete with RS232C and Modular Handset Cables, eliminates need to buy cables — save \$20.00-\$30.00, assures correct fit



- Uses low cost 9V battery. Eliminates unsightly cords and need for "another"
- AC outlet. Optional plug-in transformer available.
- Audio Transducer eliminates need to view LED to confirm connection — can be placed anywhere (velcro tape provided).
- Advanced IC Circuitry eliminates confusion of who is originator — ends need to manually switch from Originate to Answer and Vice/Versa.
- Permits you to listen/talk on phone or switch to data communications mode.
- Permits you to communicate with most other computer networks.
- Small size, light weight permits you to install the SIGNALMAN anywhere.
- Lowest priced modem available.

ANCHOR  
AUTOMATION

\$129.00

Circle 318 on Inquiry card.

#### RS232C SPECIFICATIONS

Data Format: Serial, binary, asynchronous. Operate Mode: Manual dial, Automatic ANSW/ ORIG selection. Data Rate: 0 to 300 bps, full duplex. Modulation: Frequency shift keyed (FSK). Line Interface: Direct Connect. Data Interface: RS232C. Cable to Computer Built-In.

Transmit Frequency: MARK 1270 Hz, SPACE 1070 Hz

Transmit Frequency Accuracy: 0.1%.

Receive Frequency: MARK 2225 Hz, SPACE 2025 Hz

Carrier Detect Threshold: -44 dbm, plus or minus 2 dbm (ORIG).

Indicator: Audible Tone. Power Requirement: Self-Contained — 9V Transistor Battery / 110 VAC Through Adapter.

Mechanical: 8" x 4" x 1"

BCANCMK1

\$129.00

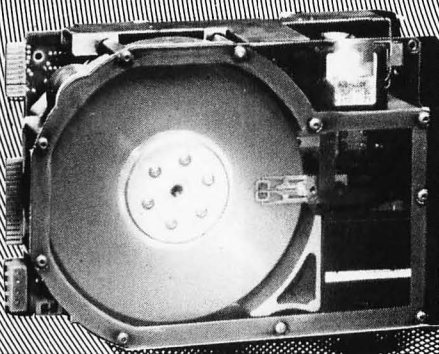
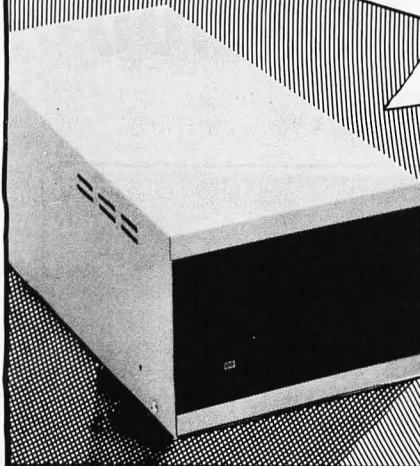
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# HARD DISK FOR LESS THAN FLOPPIES

## 5Mb LIGHTNING FAST DMA S-100 HARD DISK

SAVE \$500.00



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### DISCUS M5 by MORROW DESIGNS

PRIORITY **1** ELECTRONICS

INTRODUCTORY PRICE:

**\$1995.00**  
LIST PRICE: \$2495.00

PRIORITY 1 ELECTRONICS is pleased to announce Morrow Designs' DISCUS M5, the lowest cost 5 megabyte Winchester sub-system and the fastest. Now you can afford a hard disk for the price of floppies. Morrow Designs is the largest supplier of hard disk sub-systems to the S-100 market. With the new DMA Hard Disk Controller and the ST506 mini-Winchester drive, Morrow has attained speeds over 600,000 bytes per second.

As with all Morrow Designs' systems, Morrow delivers it complete. Drive, controller, cabinet, power supply, fan, transformer, cables, CP/M 2.2™ operating system, Microsoft™ Basic 80 and a ninety day warranty.

The DISCUS M5 regularly sells for \$2495.00. Priority 1 Electronics is proud to offer the DISCUS M5 for a limited time at only \$1995.00. Winchester speed, 5Mb capacity and reliability for only \$1995.00. Three additional drives may be daisy-chained to the controller for future expansion. Perfect to back up each other at the end of each day. Takes seconds, is more reliable than tape and with the outside lock can be unplugged and removed (after the locking screw has been put in place.)

A few facts about the ST506 drive which is being used in the Discus M5:

#### Key Features

- Storage Capacity of 6.38 megabytes unformatted, 5.0 megabytes formatted as shipped
- Winchester design reliability, 9.5 gram head load force, 19 micro-inch flying height
- Same physical size and mounting as the mini-floppy
- Same DC voltages as the minifloppy
- Band actuator and stepper motor head positioning
- 5.0 megabit/second transfer rate
- Same track capacity as a double density 8 inch floppy
- 170 millisecond random average access time, reducible to 95 ms via a simple software algorithm

This is the hard disk controller that the S-100 bus has been waiting for. Please allow us to introduce you!

#### A few interesting facts

- The only single S-100 DMA Hard disk controller board on the market today

- Fully compatible with high speed 6MHz and 8 MHz CPUs of today and tomorrow
- DMA bus arbitration as outlined by the IEEE 696 standard
- Controls 1 to 4 soft sectored Winchester drives
- Supports both 5 1/4" and 8" drives
- ST506 or SA 1000 interface compatible
- Variable sector length (256, 512, 1024, or 2048 byte sectors)
- Automatic CRC generation and checking
- Addresses 1 to 16 heads
- Addresses an infinite number of tracks
- Contains its own on-board microprocessor
- 24-bit address burst DMA transfers
- Channel driven
- All disk driver routines resident on the controller
- Variable format
- No buffering required
- Maximum transfer rate 5,000,000 bits per second

#### Pure Speed

The speed of this Winchester controller is enhanced by Morrow's channel driven concept. This DMA hard disk controller (DMAHDC) picks up its commands from the host processor via memory on the system bus. The host processor writes commands into memory and then picks them up during DMA cycles from this memory. The channel, commands and transfers may be located anywhere in the 24-bit address range. At the completion of the command, the controller returns appropriate status and can generate an interrupt. Commands may be chained together by the CPU to allow the controller to execute many commands in succession, generating an interrupt at the end of each command and/or at the end of the completed command chain.

#### Communications

An imbedded microprocessor enables the user to easily communicate with this intelligent device. All low level disk drive routines are resident on the controller itself.

These include:

- format
- seek
- read a header
- read a sector
- write a sector
- return status
- set DMA address
- set channel address

Circle 318 on inquiry card.

**Variable sector lengths are available.** On Morrow Designs system products 512 byte sector lengths are standard. This is being done to maximize the capacities available on current drive units but may be varied by independent system integrators when desired.

The DMAHDC has been designed for expansion. One to four drives can be attached directly and controlled. One to sixteen drive heads may be addressed. Any number of tracks may be specified during the seek routine by specifying one to two hundred and fifty-six tracks one or more times. Each of the expansion abilities prepare the user to upgrade his system as technology advances to additional platters and tracks.

The controller has no peer today in the S-100 bus market.

#### Systems interfaced:

- |                    |                        |
|--------------------|------------------------|
| 1. North Star      | 6. Exidy               |
| 2. Cromemco        | 7. Imsai               |
| 3. Vector Graphics | 8. Sol                 |
| 4. Dynabyte        | 9. California Computer |
| 5. Micromation     | 10. Godbout            |
|                    | 11. Ithaca Intersystem |

#### Look to Morrow for answers!

#### Look to PRIORITY 1 for the best price!

Priority 1 Electronics, as the world's largest stocking distributor of Morrow Designs' products committed to buy an entire production run of DISCUS M5 sub-systems so we can offer them at a special introductory low price. The DISCUS M5 is a good buy at the list price of \$2495.00. The DISCUS M5 is an excellent value at our introductory low price of:

**\$1995.00**

ORDER PART NO. BCMDSMAM5

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Include \$10.00 for UPS Ground Shipping

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**100 MHz Scope \$1595.00**  
**50 MHz Scope \$1250.00**

**... and we're not joking!**



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**BCHITV1050 100 MHz, List \$2375.00**

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**BCHITV550B 50 MHz, List \$1745.00**

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- 6" square CRT with internal graticule (illuminated scale)
- High sensitivity; 1mV/div. (10 MHz) V550B
- High sensitivity; .5mV/div. (10 MHz) V1050
- Automatic focus eliminates lag
- Trace rotation for easily adjusting brightline inclination caused by terrestrial magnetism
- Third Channel Display (Trigger View) V550B
- Fourth Channel Display (Trigger View) V1050

- X-Y Operation Convenient for observation of two types of waves
- Delayed sweep permits 1,000 x magnification
- Variable Hold-off circuitry facilitates pulse measurement
- Single Sweep capability
- 10 x sweep magnification facilitates precision measurement
- Delayed sweep jitter held below 1/20,000
- 2 probes and cover included
- 2 year warranty

Until now, if you wanted a 50MHz or 100MHz dual trace oscilloscope of uncompromising quality, there was only one choice. Now there is a second... outstanding new delay sweep with an established name — the Hitachi V550B and the V1050.

The HITACHI V550B (50MHz) and V1050 (100MHz) offer all the capabilities you might demand from a lab grade oscilloscope. Capabilities such as a max. sweep rate of 2ns/div (V1050) 5ns/div V550B). Also features you may not expect, like sensitivity of 1 mV/div (V550B) .5mV/div (V1050) @ 10MHz, automatic focus correction, and a built-in TV sync separator circuit.

The cost? Remarkably reasonable, especially when you compare it to the other leading 50MHz or 100MHz Dual trace oscilloscopes. It's a price breakthrough made possible by using up-to-date production techniques and a design backed up by over 20 years of oscilloscope experience.

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**BCHITV352 35 MHz, List \$1150.00**

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- 6" Square CRT with internal graticule (illuminated scale)
- High-accuracy voltage axis and time axis set at  $\pm 3\%$  (certified at 10° to 34° C)
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- Low drift
- 2 Year Warranty

- Dynamic range 8 div.
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HITACHI Oscilloscopes are innovative oscilloscopes designed and manufactured by Hitachi Denshi Ltd. The wide experience gained by HITACHI electronic specialists in producing oscilloscopes has resulted in this line of modern oscilloscopes featuring wider band width, more compact design and light weight. Through adopting circuitry with linear IC's and logic IC's plus modern manufacturing techniques, including automatic component-insertion machines. These oscilloscopes offer increased stability, improved reliability, excellent performance and enhanced operating ease.

The panel layout is designed to create maximum operating ease by considering measuring processes and operation frequency. The layout is divided into three blocks according to respective functions identified by different colors. This convenience-oriented design for users improves daily controllability and drastically reduces operating errors.

TERMS U.S.: VISA, MC, BAC, Check, Money Order, U.S. Funds Only. CA residents add 6% Sales Tax. INCLUDE \$15.00 FOR EACH OSCILLOSCOPE for UPS Surface Shipping and Handling. Just in case, include your phone number. Prices subject to change without notice. We will do our best to maintain these prices through March, 1982. For complete specifications, see our 60 page catalog in the November issue of BYTE or send \$1.00 for your copy today. Sale Prices are for prepaid orders only.

**HITACHI — THE MEASURE OF QUALITY**

Circle 319 on inquiry card

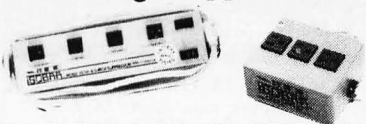




PROTECT YOUR INVESTMENT  
PROTECT YOUR DATA WITH



**With Built-In Noise Filters and Surge Suppressors**



**ISOLATES SENSITIVE AND VALUABLE EQUIPMENT FROM:**  
Equipment interaction - Damaging High Voltage Spikes - AC line noise and hash.

**PROTECTS AGAINST:** Voltage transients caused by lightning, contact switching, turn-off of inductive components, noise due to electromagnetic coupling.  
**USE THE GSC ISOBAR TO ISOLATE:** Microprocessor from peripherals - Lab instruments from noisy equipment - Sensitive pre-amp or tape deck from power amplifier.

**THE GSC ISOBAR ELIMINATES:** Equipment interaction - Equipment damage from power line spikes and surges - Errors - False printouts - Disk Skips - Audio or video hash.

**FEATURES:** Inactive isolated ground - Sockets individually filter isolated - Circuit breaker protected at 15A

**VOLTAGE TRANSIENT SPIKE PROTECTION:** 2000 A peak for up to 6 Sec duration spikes. 1000A, 8/20 Sec protection from repeated spikes.

**LOAD HANDLING:** 1875 W max. total load. 15A per socket. **INPUT:** 125 VAC, 15 amps; standard 3-prong plug.

Three common outlets built-in circuit breaker, pilot light, hang-up bracket and a 6 foot cord.

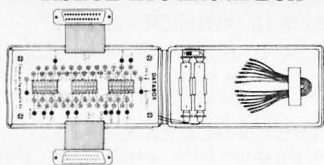
BCGOFIBAR3	SH. WT. 3 lbs.	LIST PRICE	OUR PRICE
		\$59.95	\$39.95

IBAR 46	Four independently isolated outlets. Built-in 15A circuit breaker, pilot light, switch, and 6 foot cord.	SH. WT. 4 lbs.	\$79.95	\$49.95
BCGOFIBAR46				

IBAR 86	8 outlets, grouped to form 4 independently isolated sets of two. Built in 15A circuit breaker, on/off switch, pilot light.	SH. WT. 5 lbs.	\$84.95	\$54.95
BCGOFIBAR86				

IBAR 9RM	Eight rear-mounted outlets grouped to form four independently isolated sets of two, plus one non-isolated convenience outlet on front face. 19" rack mount cabinet. Built in 15A circuit breaker, pilot light, on/off switch, and 6 foot cord.	SH. WT. 6 lbs.	\$99.95	\$74.95
BCGOFIBAR9RM				

## RS232 Breakout Box



A must for every technician, repair man or systems integrator

The Breakout Box contains 24 Dual-In-Line Switches which allow any of the interface signals (except Pin 1, which is not used) to be interrupted. The switches are located in the center of the main control panel. A 25 way female connector for connecting the box to the DTE is fitted to the left hand side via a ribbon cable and a 25 way male connector for connection to the DCE is similarly connected to the right hand side.

DTE and DCE interface connection pins are located on both sides of the Dual-In-Line switches. Using the jumpers supplied, these pins permit monitoring of any of the interface lines with either or both the positive and negative test indicators on the front panel. These pins also permit cross-patching or the connection of an external test meter or oscilloscope.

The Breakout Box contains indicators which monitor the following signals:

Pin	Function
2	Transmitted Data
3	Received Data
4	Request to Send
5	Ready for Sending (clear to send)
6	Data Set Ready
8	Data Channel Received Line Signal Detector
15	Transmitter Signal Element Timing
17	Receiver Signal Element Timing
20	Connect Data Set to Line/Data Terminal Ready
21	Signal Quality
22	Ring Indicator
25	Busy

Databox is contained in a tough plastic case and is powered by two, 1.5 volt penlight batteries. No power is consumed by the tester when not in use. Dimensions: 2.9" x 5.55" x 1.45". Weight: 10 ounces, with batteries.

BCDNW232BOX	\$199.00	\$159.00
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## GLOBAL SPECIALTIES LOGIC PROBES

SPECIFICATIONS

MODEL	LP1	LP2	LP3
Response	50 ns, 80 ns single-shot event, 10MHz pulse train	300 ns, 1.5MHz pulse train	6 ns typical, tested at 10 ns, 70MHz pulse train
Pulse Mode	High Speed Train or Single Event		
Part No.	Description	List Price	Our Price
BCGS65CLP1	Standard 10MHz w/Memory	\$50.00	\$45.00
BCGS65CLP2	Economy 1.5MHz	\$32.00	\$30.00
BCGS65CLP3	High Speed 50MHz w/Memory	\$77.00	\$69.00
BCGS65CLP1	High speed Digital Pulsar, 100 nsec or single-shot	\$83.00	\$76.00
BCGS65CLT1	LP1, DP1 and LMI in molded case	\$240.00	\$220.00
BCGS65CLT2	LP3, DP1 and LMI in molded case	\$270.00	\$245.00

Shipping Wt. 2 lbs

## MICROCOMPUTER PRODUCTS

MEMORY			
PART NO.	PRICE	PART NO.	PRICE
BC4116AC20	8/\$20.00	BCINS 8080A	\$5.50
BC2016P3	8/\$72.00	BCINS 8085A	\$19.95
BC2114N3L	8/\$28.00	BCDP8212N	\$2.95
BC5257N3L	8/\$50.00	BCDP8214N	\$5.25
BC2732	8/\$120.00	BCDP8216N	\$2.95
BC2716	8/\$50.00	BCDP8224N	\$3.25
BC2708	8/\$20.00	BCDP8224-4N	\$9.95
Z80 SERIES			
BCZ80A	\$14.95	BCDP8226N	\$3.50
BCZ80AP10	\$14.95	BCDP8228N	\$5.55
BCZ80ACTC	\$13.95	BCDP8238N	\$5.55
BCZ80ADMA	\$45.00	BCINS8250N	\$15.00
BCZ80AS100	\$59.95	BCINS8251N	\$7.50
BCZ80AS101	\$59.95	BCINS8253N	\$17.95
BCZ80AS102	\$59.95	BCINS8255N	\$6.80
UARTS			
BCAY51013A	\$5.95	BCINS8257N	\$16.45
BCTR1602B	\$5.95	BCINS8259N	\$18.00
BCTR1863	\$6.95	BCINS8275N	\$59.95
BCIM6402	\$7.95	BCINS8279N	\$49.95
FLOPPY DISC CONTROLLER			
BCFD1771B-01	\$24.95		
BCFD1791B-01	\$44.95		

## KEITHLEY

### Handheld DMMs For Every Application and Budget

Easy-to-use Rotary Switches

Large 0.6" LCD displays

dc Voltage

dc Current

ac Voltage

ac Current

Resistance

Diode Test

3 1/2 or 4 1/2 Digit Accuracy

Overload Protection

Externally Accessable Battery & Fuse

Rugged 0.1" ABS Plastic Case

Shock-Mounted PC Board

**BCKTH130**  $\pm 0.5\%$  DCV accuracy, 10M  $\Omega$  input impedance auto polarity and current measurement through 10A **\$124.00**

**BCKTH131** Same as BCKTH130 except 0.25% accuracy and enhanced band with on top ACV ranges **\$139.00**

**BCKTH128** See/hear display includes both over/under threshold indicator arrows, audible tone that operates on all ranges & functions, and adjustable threshold. **\$139.00**

**BCKTH135** 4 1/2 digit, 0.05% accuracy **\$235.00**

**BCKTH870** Thermocouple(TC)based thermometer **\$199.00**

**BCKTH1304** Soft Carrying Case & Stand(handhelds) **\$10.00**

**BCKTH1306** Deluxe Carrying Case (handhelds) **\$25.00**

**LCD & LED Bench DMMs**

**BCKTH169** 3 1/2 Digit, LCD Display **\$189.00**

**BCKTH176** 4 1/2 Digit, LCD Display **\$269.00**

**BCKTH179A** 4 1/2 Digit, LED Display, TRMS **\$359.00**

**BCKTH1793** IEEE-488 Interface(Model 179-20A) **\$325.00**

See pp. 42-43 of our Engineering Selection Guide in the November **BYTE** for a complete list of specifications and accessories.

**SPECIAL PURCHASE**

**GOLD**

**16 PIN LOW PROFILE IC.**

**C95 SOCKETS**

**BCTIG16LP** pkg of 100 **\$16.00**

**BCTIG16LP** pkg of 1000 **\$120.00**

**OEMS** Stock up at this **LOW PRICE!**

**ZERO INSERTION FORCE TEST SOCKETS**

**BCZIP16 DIP** 1-9 **\$5.50** 10-24 **\$5.35**

**BCZIP24 DIP** 1-9 **\$7.50** 10-24 **\$7.25**

**BCZIP40 DIP** 1-9 **\$10.25** 10-24 **\$9.85**

**PRIORITY ONE ELECTRONICS**

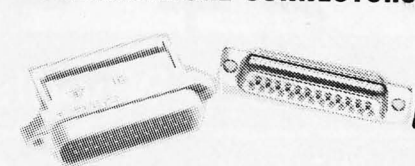
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Include MINIMUM SHIPPING & HANDLING of \$2.50 for the first 3 lbs. plus 25¢ for each additional pound. Orders over 50 lbs. sent freight collect. Just in case, please include your phone no. Prices subject to change without notice. We will do our best to maintain prices through March, 1982. Credit Card orders will be charged appropriate freight. See November **BYTE** for 60 page Catalog or send \$1.00 for your copy today. Sale prices are for prepaid orders only.

## D-SUBMINIATURE CONNECTORS



### INSULATION DISPLACEMENT TYPE

P = Plug, Male Type - S = Socket, Female Type - C = Cover Hood

PART NO.	NO. OF PINS	1-9	10-24	25-99	100-249
BCIDCDESP	9	4.20	4.00	3.60	3.20
BCIDCDESS	9	4.50	4.20	3.80	3.40
BCIDCDESC	9	1.25	1.10	1.00	.95
BCIDCDA15P	15	4.35	4.20	3.75	3.40
BCIDCDA15S	15	5.00	4.85	4.35	3.90
BCIDCDA15C	15	1.40	1.25	1.10	.95
BCIDCDB25P	25	6.25	6.00	5.20	4.70
BCIDCDB25S	25	6.60	6.35	5.60	5.00
BCIDCDB25C	25	1.60	1.50	1.35	1.20
BCIDCDB37P	37	8.80	8.00	7.20	6.40
BCIDCDB37S	37	11.00	10.25	9.20	8.20
BCIDCDB37C	37	2.25	2.20	1.80	1.60

### SOLDER TYPE

PART NO.	DESCRIPTION	1-9	10-24	25-99
BCCNDB25P	9 Pin Male	\$2.10	\$1.90	\$1.70
BCCNDB25S	9 Pin Female	\$2.70	\$2.40	\$2.10
BCCNDB25C	9 Pin Cover	\$1.50	\$1.25	\$1.10
BCCNDBA15P	15 Pin Male	\$2.75	\$2.45	\$2.15
BCCNDBA15S	15 Pin Female	\$3.95	\$3.60	\$3.20
BCCNDBA15C	15 Pin Cover	\$1.50	\$1.30	\$1.10
BCCNDB25P	25 Pin Male	\$3.00	\$2.75	\$2.25
BCCNDB25S	25 Pin Female	\$4.00	\$3.75	\$3.00
BCCNDB25S	25 Pin Female	\$4.00	\$3.75	\$3.00
BCCNDBS1226	2 Pc. Black Hood	\$1.90	\$1.65	\$1.45
BCCNDBS1212	1 Pc. Grey Hood	\$1.60	\$1.45	\$1.30
BCCNDBP25H	2 Pc. Grey Hood	\$1.50	\$1.25	\$1.10
BCCNDBC37P	37 Pin Male	\$5.80	\$5.10	\$4.45
BCCNDBC37S	37 Pin Female	\$8.70	\$7.70	\$6.70
BCCNDBC37C	37 Pin Cover	\$1.80	\$1.55	\$1.30
BCCNDB50P	50 Pin Male	\$8.75	\$7.75	\$6.70
BCCNDB50S	50 Pin Female	\$11.65	\$10.25	\$8.90
BCCNDB50C	50 Pin Cover	\$2.00	\$1.80	\$1.60
BCCNDB20418	Hardware Set 2 Pr. RS232, DB25P, EIA Class 1 Cable 8 Con. 8 Ft.	\$19.95	\$17.95	\$15.95
BCCNDB5730360	Cent. 700 Series/Epson Printer Conn.	\$9.00	\$7.50	\$6.00
BCIDC5730360	IDC Version of Above	\$9.95	\$9.00	\$8.00



### THE STAR

### MODEM

### from

### PRENTICE

### FEATURE

### FITS GTE HANDSETS!

### 1 YEAR WARRANTY

### EXCLUSIVE ACOUSTIC CHAMBERS:

### SELF TEST:

### SPECIFICATIONS:

### ● Data Rate: 0 to 300 baud

### ● Compatibility: Bell 103 and 113; CCITT

### ● Frequency Stability: $\pm 0.3$ percent. Crystal controlled

### ● Receiver Sensitivity: -50 dBm ON -53 dBm OFF

### ● Modulation: Frequency shift keyed (FSK)

### ● Carrier Detect Delay: 1.2 seconds ON; 120 sec OFF

### ● EIA Terminal Interface: Compatible with RS232 specs.

### ● Teletype Interface: 20 millampere current loop

### ● International (CCITT) frequencies available.

### ● Switches: Originate/Off/Answer/Full duplex/Test/-Half Duplex

### ● Indicators: Transmit Data, Receive Data, Carrier Ready, Test.

### PART NO. DESCRIPTION LIST PRICE SALE PRICE

### BCPRNSTAR RS232, TTL 200 Ma Current Loop \$199.00 \$129.00

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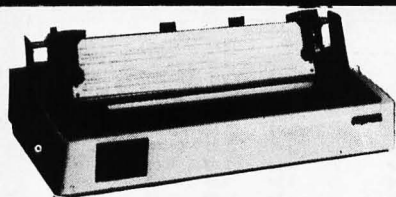


# JADIE

## Computer Products

Sunnyvale • Woodland Hills • Hawthorne • San Diego

### Printers



#### BETTER THAN EPSON! - Okidata

**Microline 82A** 80/132 column, 120 CPS, 9 x 9 dot matrix, friction feed, pin feed, adjustable tractor feed (removable), handles 4 part forms up to 9.5" wide, rear & bottom feed, paper tear bar, 100% duty cycle/200,000,000 character print head, bi-directional/logic seeking, both serial & parallel interfaces included, front panel switch & program control of 10 different form lengths, uses inexpensive spool type ribbons, double width & condensed characters, true lower case descenders & graphics  
**PRM-43082 with FREE tractor** .... \$544.95

**Microline 83A** 132/232 column, 120 CPS, handles forms up to 15" wide, plus all the features of the 82A.  
**PRM-43083 with FREE tractor** .... \$774.95

**Microline 84** 132/232 column, 200 CPS, full dot graphics built in, handles forms up to 15" wide, plus all the features of the 83A.  
**PRM-43083 with FREE tractor** ... \$1249.95

**PRA-27081 Apple card** ..... \$39.95  
**PRA-27082 Apple cable** ..... \$19.95  
**PRA-27087 TRS-80 cable** ..... \$24.95  
**PRA-43081 Hi speed 2K serial board** \$169.95  
**PRA-43080 Extra ribbons pkg. of 2** ... \$9.95

#### INEXPENSIVE PRINTERS - Epson

**MX-70** 80 column, 80 CPS, 5 x 7 dot matrix, adjustable tractor feed, & graphics

**PRM-27070 List \$459** ..... \$399.95

**MX-80** 80 column, 80 CPS, bi-directional/logic seeking printing, 9 x 9 dot matrix, adjustable tractor feed, & 64 graphics characters

**PRM-27080 List \$645** ..... \$469.95

**MX-80FT** same as MX-80 with friction feed added.

**PRM-27082 List \$745** ..... \$559.95

**MX-100** 132 column, correspondence quality, graphics, up to 15" paper, friction feed & adjustable tractor feed, 9 x 9 dot matrix, 80 CPS.

**PRM-27100 List \$945** ..... \$759.95

**PRA-27084 Serial interface** ..... \$69.95

**PRA-27088 Serial int'f & 2K buffer** .. \$144.95

**PRA-27081 Apple card** ..... \$74.95

**PRA-27082 Apple cable** ..... \$22.95

**PRA-27086 IEEE 488 card** ..... \$52.95

**PRA-27087 TRS-80 cable** ..... \$32.95

**PRA-27085 Graftrax II** ..... \$95.00

**PRA-27083 Extra ribbon** ..... \$14.95

### Modems

#### SMARTMODEM - Hayes

Sophisticated direct-connect auto-answer/auto-dial modem,

touch-tone or pulse dialing, RS-232C interface, programmable

**IOM-5400A Smartmodem** ..... \$249.95

**IOM-1500A Hayes Chronograph** ... \$199.95

#### CAT MODEMS - Novation

**CAT** 300 baud, acoustic, answer/originate

**IOM-5200A List \$189.95** ..... \$149.95

**D-CAT** 300 baud direct connect, answer/originate

**IOM-5201A List \$199.95** ..... \$169.95

**AUTO-CAT** Auto answer/originate, direct connect

**IOM-5230A List \$299.95** ..... \$239.95

#### Apple-CAT - Novation

Software selectable 1200 or 300 baud, direct connect, auto-answer, auto-dial, auxiliary 3-wire RS232C serial port for printer.

**IOM-5232A Save \$50.00!!!** ..... \$325.00

### Accessories for Apple

#### 16K MEMORY UPGRADE

Add 16K of RAM to your TRS-80, Apple, or Exidy in just minutes. We've sold thousands of these 16K RAM upgrades which include the appropriate memory chips (as specified by the manufacturer), all necessary jumper blocks, fool-proof instructions, and our 1 year guarantee.

**MEX-16100K TRS-80 kit** ..... \$25.00

**MEX-16101K Apple kit** ..... \$25.00

**MEX-16102K Exidy kit** ..... \$25.00

#### 16K RAM CARD - for Apple II

Expand your Apple to 64K, 1 year warranty

**MEX-16500A Save \$70.00 !!!** ..... \$129.95

#### Z-80\* CARD for APPLE

Two computers in one, Z-80 & 6502, more than doubles the power & potential of your Apple, includes Z-80\* CPU card, CP/M 2.2, & BASIC-80

**CPX-30800A A & T** ..... \$299.95

#### 8" DISK CONTROLLER

New from Vista Computer, single or double sided, single or double density, compatible with DOS 3.2/3.3, Pascal, & CPM 2.2, Shugart & Qume compatible

**IOD-2700A A & T** ..... \$499.95

#### 2 MEGABYTES for Apple II

Complete package includes: Two 8" double-density disk drives, Vista double-density 8" disk controller, cabinet, power supply, & cables, DOS 3.2/3.3, CP/M 2.2, & Pascal compatible.

**1 MegaByte Package (Kit)** ..... \$1495.00

**1 MegaByte Package (A & T)** ..... \$1695.00

**2 MegaByte Package (Kit)** ..... \$1795.00

**2 MegaByte Package (A & T)** ..... \$1995.00

#### DISK DRIVES - Micro Sci

Inexpensive disk drives for your Apple

**A2** Direct replacement for Apple Disk II, works with Apple II controller as first or second drive.

**MSM-123101 Micro Sci A2** ..... \$429.95

**A40** 40 track drive for Apple II. Improved storage capacity and speed over Apple Brand drives - requires Micro Sci controller.

**IOD-2340A Micro Sci A40** ..... \$399.95

**A70** 70 track drive for Apple II. Twice the storage capacity and three times faster than Apple Brand drives - requires Micro Sci controller

**IOD-2370A Micro Sci A70** ..... \$499.95

**Micro Sci Controller** Disk controller for up to two Micro Sci A40 or A70 disk drives, DOS 3.2, 3.3, Pascal, and Z-80 SoftCard compatible, includes utility disk and 40/70 track patch.

**IOD-2300A Micro Sci controller** ..... \$95.00

#### VISION 80 - Vista Computer

80 column x 24 line video card for Apple II, 128 ASCII characters, upper and lower case, 9 x 10 dot matrix with 3 dot descenders, standard data media terminal control codes, CP/M Pascal & Fortran compatible, 50/60 Hz

**IOV-2400A Vista Vision 80** ..... \$375.00

#### AIO, ASIO, APIO - S.S.M.

Parallel & serial interface for your Apple (see Byte pg 11)

**IOI-2050K Par & Ser kit** ..... \$139.95

**IOI-2050A Par & Ser A & T** ..... \$169.95

**IOI-2052K Serial kit** ..... \$89.95

**IOI-2052A Serial A & T** ..... \$99.95

**IOI-2054K Parallel kit** ..... \$69.95

**IOI-2054A Parallel A & T** ..... \$89.95

#### CPS MULTICARD - Mtn. Computer

Three cards in one! Real time clock - calendar, serial interface, & parallel interface - all on one card.

**IOX-2300A A & T** ..... \$199.95

Circle 200 on inquiry card.

### Single Board Computer

#### Z-80 STARTER KIT - SD Systems

Complete Z-80 microcomputer with RAM, ROM, I/O, keyboard, display, kludge area, manual, & workbook

**CPS-30100K KIT** ..... \$299.95

**CPS-30100A A & T** ..... \$469.95

#### SYM-1 - Synertek Systems

Single board computer with 1K of RAM, 4K of ROM, key-pad, LED display, 20ma & cassette interface on board.

**CPK-50020A A & T** ..... \$249.95

#### VIC 20 - Commodore

Complete personal computer with 5K RAM, full color, 61 key keyboard, 4 dual special-function keys, serial ports, cassette port, composite video output (connects to standard color TV set), BASIC language, & expansion port.

**COM-VIC20 VIC-20** ..... Under \$300.00

### PERSONAL COMPUTERS

Also available from Jade - Call for Price and Info

**AIM-65, Altos, Apple II, Atari,**

**Commodore, California Computer Sys**

**Hewlett-Packard, Intersystems**

**Jade, NEC, Novell, SD Systems**

**SYM-1, Xerox, and more...**

### Video Monitors

#### HI-RES 12" GREEN - Zenith

15 MHz bandwidth, 700 lines/inch, P31 green phosphor, switchable 40 or 80 columns, small, light-weight & portable.

**VDM-201201 List price \$150.00** .... \$118.95

#### 12" GREEN SCREEN - NEC

20 MHz, P31 phosphor video monitor with audio, exceptionally high resolution - A fantastic monitor at a very reasonable price

**VDM-651200 Special Sale Price** ..... \$199.95

#### 12" COLOR MONITOR - NEC

Hi-res monitor with audio & sculptured case

**VDC-651212 Color Monitor** ..... \$479.95

**NEC-1202D RGB color monitor** ... \$1045.00

#### Leedex / Amdek

Reasonably priced video monitors

**VDM-801210 Video 100 12" B&W** .. \$139.95

**VDM-801230 Video 100-80 12" B&W** \$179.95

**VDM-801250 12" Green Phosphor** .... \$169.95

**VDC-801310 13" Color I** ..... \$379.95

**VDC-801320 Color II** ..... \$895.00

**IOV-2300A DVM board for Apple** .. \$199.95

### Video Terminals

#### TELEVIDEO 910

Full featured - inexpensive terminal

**VDT-901210 List 795.00** ..... \$695.00

#### TELEVIDEO 950

**VDT-901250 List \$1195.00** ..... \$995.00

#### AMBER SCREEN - Volker Craig

Detachable keyboard, amber on black display, 7 x 9 dot matrix, 10 program function keys, 14 key numeric pad, 12" non-glare screen, 50 to 19,200 baud, direct cursor control, auxiliary bi-directional serial port

**VDT-351200 List \$795.00** ..... \$645.00

#### VIEWPIONT - ADDS

Detachable keyboard, serial RS232C interface, baud rates from 110 to 19,200, auxiliary serial output port, 24 x 80 display.

**VDT-501210 Sale Priced** ..... \$639.95

#### DIALOGUE 80 - Ampex

**VDT-230080 List \$1195.00** ..... \$895.00



# JADE

# Computer Products

## FREE 1982 CATALOG

Just circle our reader service number on the information request card located near the index.

### S-100 CPU Boards

#### THE BIG Z\* - Jade

2 or 4 MHz switchable Z-80\* CPU with serial I/O, accommodates 2708, 2716, or 2732 EPROM, baud rates from 75 to 9600

CPU-30201K Kit	\$139.95
CPU-30201A A & T	\$189.95
CPU-30200B Bare board	\$35.00

#### 2810 Z-80\* CPU - Cal Comp Sys

2/4 MHz Z-80A\* CPU with RS-232C serial I/O port and on board MOSS 2.2 monitor PROM, front panel compatible

CPU-30400A A & T	\$269.95
------------------	----------

#### CB-2 Z-80 CPU - S.S.M.

2 or 4 MHz Z-80 CPU board with provision for up to 8K of ROM or 4K of RAM on board, extended addressing, IEEE S-100, front panel compatible.

CPU-30300K Kit	\$239.95
CPU-30300A A & T	\$299.95

### S-100 PROM Boards

#### PROM-100 - SD Systems

2708, 2716, 2732 EPROM programmer w/software

MEM-99520K Kit	\$189.95
MEM-99520A A & T	\$249.95

#### PB-1 - S.S.M.

2708, 2716 EPROM board with built-in programmer

MEM-99510K Kit	\$154.95
MEM-99510A A & T	\$219.95

#### EPROM BOARD - Jade

16K or 32K uses 2708's or 2716's, 1K boundary

MEM-16230K Kit	\$79.95
MEM-16230A A & T	\$119.95

### S-100 Video Boards

#### VB-3 - S.S.M.

80 characters x 24 lines expandable to 80 x 48 for a full page of text, upper & lower case, 256 user defined symbols, 160 x 192 graphics matrix, memory mapped, has key board input.

IOV-1095K 4 MHz kit	\$349.95
IOV-1095A 4 MHz A & T	\$439.95
IOV-1096K 80 x 48 upgrade	\$39.95

#### VDB-8024 - SD Systems

80 x 24 I/O mapped video board with keyboard I/O, and on-board Z-80A\*.

IOV-1020A A & T	\$459.95
-----------------	----------

#### VIDEO BOARD - S.S.M.

64 characters x 16 lines, 128 x 48 matrix for graphics, full upper/lower case ASCII character set, numbers, symbols, and greek letters, normal/reverse/blinking video, S-100.

IOV-1051K Kit	\$149.95
IOV-1051A A & T	\$219.95
IOV-1051B Bare board	\$34.95

### S-100 Motherboards

#### ISO-BUS - Jade

Silent, simple, and on sale - a better motherboard  
6 Slot (5 1/4" x 8 1/2")

MBS-061B Bare board	\$19.95
MBS-061K Kit	\$39.95
MBS-061A A & T	\$49.95

12 Slot (9 3/4" x 8 1/2")

MBS-121B Bare board	\$29.95
MBS-121K Kit	\$69.95
MBS-121A A & T	\$89.95

18 Slot (14 1/2" x 8 1/2")

MBS-181B Bare board	\$49.95
MBS-181K Kit	\$99.95
MBS-181A A & T	\$139.95

### S-100 RAM Boards

#### MEMORY BANK - Jade

4 MHz, S-100, bank selectable, expandable from 16K to 64K

MEM-99730B Bare Board	\$49.95
MEM-99730K Kit no RAM	\$199.95
MEM-32731K 32K Kit	\$239.95
MEM-64733K 64K Kit	\$279.95
Assembled & Tested	add \$50.00

#### 64K RAM - Calif Computer Sys

4 MHz bank port / bank byte selectable, extended addressing, 16K bank selectable, PHANTOM line allows memory overlay, 8080 / Z-80 / front panel compatible.

MEM-64565A A & T	\$575.00
------------------	----------

#### 64K STATIC RAM - Mem Merchant

64K static S-100 RAM card, 4-16K banks, up to 8MHz

MEM-64400A A & T	\$789.95
------------------	----------

#### 32K STATIC RAM - Jade

2 or 4 MHz expandable static RAM board uses 2114L's

MEM-16151K 16K 4 MHz kit	\$169.95
MEM-32151K 32K 4 MHz kit	\$299.95
Assembled & tested	add \$50.00

#### 16K STATIC RAM - Mem Merchant

4 MHz 16K static RAM board, IEEE S-100, bank selectable, Phantom capability, addressable in 4K blocks, "disable-able" in 1K segments, extended addressing, low power

MEM-16171A A & T	\$164.95
------------------	----------

### S-100 Disk Controllers

#### DOUBLE-D - Jade

Double density controller with the inside track, on-board Z-80A\*, printer port, IEEE S-100, can function on an interrupt driven buss

IOD-1200K Kit	\$299.95
IOD-1200A A & T	\$375.00
IOD-1200B Bare board	\$59.95

#### DOUBLE DENSITY - Cal Comp Sys

5 1/4" and 8" disk controller, single or double density, with on-board boot loader ROM, and free CP/M 2.2\* and manual set.

IOD-1300A A & T	\$374.95
-----------------	----------

### S-100 I/O Boards

#### S.P.I.C. - Jade

Our new I/O card with 2 SIO's, 4 CTC's, and 1 PIO

IOI-1045K 2 CTC's, 1 SIO, 1 PIO	\$179.95
IOI-1045A A & T	\$239.95
IOI-1046K 4 CTC's, 2 SIO's, 1 PIO	\$219.95
IOI-1046A A & T	\$299.95
IOI-1045B Bare board w/ manual	\$49.95

#### I/O-4 - S.S.M.

2 serial I/O ports plus 2 parallel I/O ports

IOI-1010K Kit	\$179.95
IOI-1010A A & T	\$249.95
IOI-1010B Bare board	\$35.00

### S-100 Mainframes

#### MAINFRAME - Cal Comp Sys

12 slot S-100 mainframe with 20 amp power supply

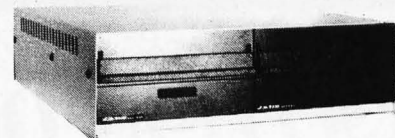
ENC-112105 Kit	\$329.95
ENC-112106 A & T	\$399.95

#### EPROM ERASER - Spectronics

Ultra-violet EPROM erasers

XME-3100A With out timer	\$69.50
XME-3101 With timer	\$94.50
XME-3200 Economy Model	\$39.95

### Disk Drives



Handsome metal cabinet with proportionally balanced air flow system • Rugged dual drive power supply • Power cable kit • Power switch, line cord, fuse holder, cooling fan • Never-Mar rubber feet • All necessary hardware to mount 2-8" disk drives, power supply, and fan • Does not include signal cable

#### Dual 8" Subassembly Cabinet

END-000420 Bare cabinet	\$59.95
END-000421 Cabinet kit	\$225.00
END-000431 A & T	\$359.95

#### 8" Disk Drive Subsystems

##### Single Sided, Double Density

END-000423 Kit w/2 FD100-8Ds	\$924.95
END-000424 A & T w/2 FD100-8Ds	\$1124.95
END-000433 Kit w/2 SA-801Rs	\$999.95
END-000434 A & T w/2 SA-801Rs	\$1195.00

#### 8" Disk Drive Subsystems

##### Double Sided, Double Density

END-000426 Kit w/2 DT-8s	\$1224.95
END-000427 A & T w/2 DT-8s	\$1424.95
END-000436 Kit w/2 SA-851Rs	\$1295.00
END-000437 A & T w/2 SA-851Rs	\$1495.00

## 5 1/4" Disk Drives

Shugart SA400L sngl-sided dbl-density 40 track

MSM-104000 .. \$234.95 ea 2 for \$224.95 ea

Shugart SA450 dbl-sided dbl-density 70 track

MSM-104500 .. \$349.95 ea 2 for \$329.95 ea

Qume DT-5 dbl-sided dbl-density 80 track

MSM-750050 .. \$359.95 ea 2 for \$349.95 ea

MPI B-51 sngl-sided dbl-density 40 track

MSM-155100 .. \$234.95 ea 2 for \$224.95 ea

MPI B-52 dbl-sided dbl-density 40 track

MSM-155200 .. \$344.95 ea 2 for \$334.95 ea

MPI B-91 sngl-sided dbl-density 77 track

MSM-155300 .. \$369.95 ea 2 for \$359.95 ea

MPI B-92 dbl-sided dbl-density 77 track

MSM-155400 .. \$469.95 ea 2 for \$459.95 ea

## 8" Disk Drives

Shugart SA801R single-sided double-density

MSF-10801R .. \$394.95 ea 2 for \$389.95 ea

Shugart SA851R double-sided double-density

MSF-10851R .. \$554.95 ea 2 for \$529.95 ea

Qume DT-8 double-sided double-density

MSF-750080 .. \$524.95 ea 2 for \$499.95 ea

Siemens FDD 100-8 sngl-sided dbl-density

MSF-201120 .. \$384.95 ea 2 for \$349.95 ea

#### BUS PROBE - Jade

S-100 diagnostic analyzer board, dynamic visual display of all 96 IEEE S-100 signals, aids in real time analysis of faulty hardware and software

TSX-200B Bare Board	\$59.95
TSX-200K Kit	\$119.95
TSX-200A A & T	\$149.95



# SD Systems ExpandoRAM III

## 256K RAM \$879.95

### Single User System

SBC-200, 64K ExpandoRAM II, Versafloppy II, CP/M 2.2

## \$1095.00

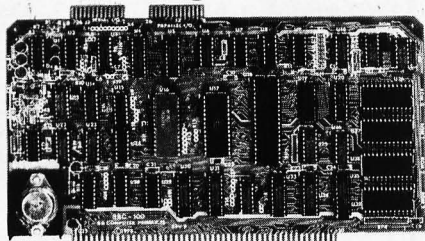
4 MHz Z-80A CPU, 64K RAM, serial I/O port, parallel I/O port, double-density disk controller, CP/M 2.2 disk and manuals, system monitor, control and diagnostic software.

Add \$100.00 for upgrade to ExpandoRAM III 64K (expandable to 256K)

*-All boards are assembled and tested-*

### SBC-200

2 or 4 MHz single board computer



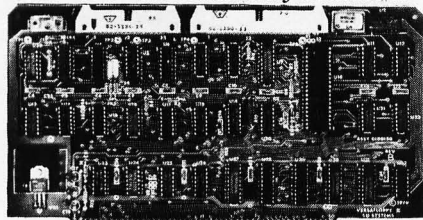
- S-100 bus compatible • Powerful 4MHz Z-80A CPU • Synchronous/asynchronous serial I/O port with RS-232 interface and software programmable baud rates up to 9600 baud • Parallel input and parallel output port • Four channel counter/timer • Four maskable, vectored interrupt inputs and a non-maskable interrupt • 1K of on-board RAM • Up to 32K of on-board ROM • System monitor PROM included

The SBC-200 is an excellent CPU board to base a microcomputer system around. With on-board RAM, ROM, and I/O, the SBC-200 allows you to build a powerful three-board system that has the same features found in most five-board microcomputers. The SBC-200 is compatible with both single-user and multi-user systems.

CPU-30200A A & T with monitor \$299.95

### Versafloppy II

5 1/4" & 8" double density controller



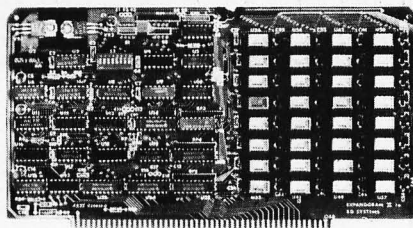
- S-100 bus compatible • IBM 3740 compatible soft sector format • Controls single and double-sided drives, single or double density, 5 1/4" and 8" drives in any combination of four simultaneously • Drive select and side select circuitry • Analog phase-locked loop data separator • Vectored interrupt operation optional • Standard CP/M 2.2 disk operating • Control/diagnostic software PROM included

The Versafloppy II is faster, more stable and more tolerant of bit shift and "jitter" than most controllers. All control and diagnostic software included.

IOD-1160A A & T ..... \$359.95  
For CP/M 2.2 and manual set add ..... \$99.95

### ExpandoRAM III

64K to 256K expandable RAM board



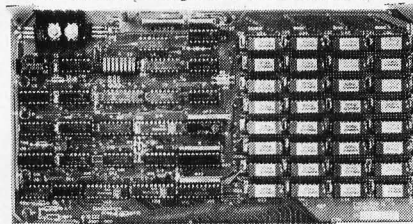
SD Systems has duplicated the famous reliability of their ExpandoRAM I and II boards in the new ExpandoRAM III, a board capable of containing 256K of high speed RAM. Utilizing the new 64K x 1 dynamic RAM chips, you can configure a memory of 64K, 128K, 192K, or 256K, all on one S-100 board. Memory address decoding is done by a programmed bipolar ROM so that the memory map may be dip-switch configured to work with either COSMOS/MPM-type systems or with OASIS-type systems.

Extensive application notes concerning how to operate the ExpandoRAM III with Cromemco, Intersystems, and other popular 4 MHz Z-80 systems are contained in the manual.

MEM-65064A	64K A & T	.....	\$495.00
MEM-65128A	128K A & T	.....	\$639.95
MEM-65192A	192K A & T	.....	\$769.95
MEM-65256A	256K A & T	.....	\$879.95

### ExpandoRAM II

16K to 64K expandable RAM board



- S-100 bus compatible • Up to 4MHz operation • Expandable from 16K to 64K • Uses 16 x 1 4116 memory chips • Page mode operation allows up to 8 memory boards on the bus • Phantom output disable • Invisible on-board refresh

The ExpandoRAM II is compatible with most S-100 CPUs. When other SD System' series II boards are combined with the ExpandoRAM II, they create a microcomputer system with exceptional capabilities and features.

MEM-16630A	16K A & T	.....	\$345.00
MEM-32631A	32K A & T	.....	\$365.00
MEM-48632A	48K A & T	.....	\$385.00
MEM-64633A	64K A & T	.....	\$399.95

### PROM-100

Versatile EPROM Programmer

- S-100 bus compatible • Programs 2708, 2758, 2716, 2732, 2516 EPROMs • DIP switch selection of EPROM type • 25 VDC programming pulse generated on-board • Very fast programming and verification • Zero insertion force socket • Programming software included on 8" diskette

MEM-99520K	Kit w/software	.....	\$189.95
MEM-99520A	A & T w/software	...	\$249.95

### Multi-User System

SBC-200, 256K ExpandoRAM III, Versafloppy II, MPC-4 COSMOS Multi-User Operating System, C BASIC II

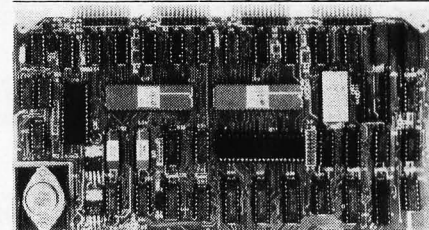
## \$1995.00

Two Z-80A CPUs (4 MHz), 256K RAM, 5 serial I/O ports with independently programmable baud rates and vectored interrupts, parallel input port, parallel output port, 8 counter/timer channels, real time clock, single and double sided/single or double density disk controller for 5 1/4" and 8" drives, up to 36K of on-board ROM, CP/M 2.2 compatible COSMOS interrupt driven multi-user disk operating system, allows up to 8 users to run independent jobs concurrently, C BASIC II, control and diagnostic software in PROM included.

*-All boards are assembled and tested-*

### MPC-4

Intelligent communications interface



- Four buffered serial I/O ports • On-board Z-80A processor • Four CTC channels • Independently programmable baud rates • Vectored interrupt capability • Up to 4K of on-board PROM • Up to 2K of on-board RAM • On-board firmware

This is not just another four-port serial I/O board! The on-board processor and firmware provide sufficient intelligence to allow the MPC-4 to handle time consuming I/O tasks, rather than loading down your CPU. To increase overall efficiency, each serial channel has an 80 character input buffer and a 128 character output buffer. The on-board firmware can be modified to make the board SDLC or BISYNC compatible. In combination with SD's COSMOS operating system (which is included with the MPC-4), this board makes a perfect building block for a multi-user system.

IOI-1504A A & T with COSMOS .. \$495.00

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213-973-7707

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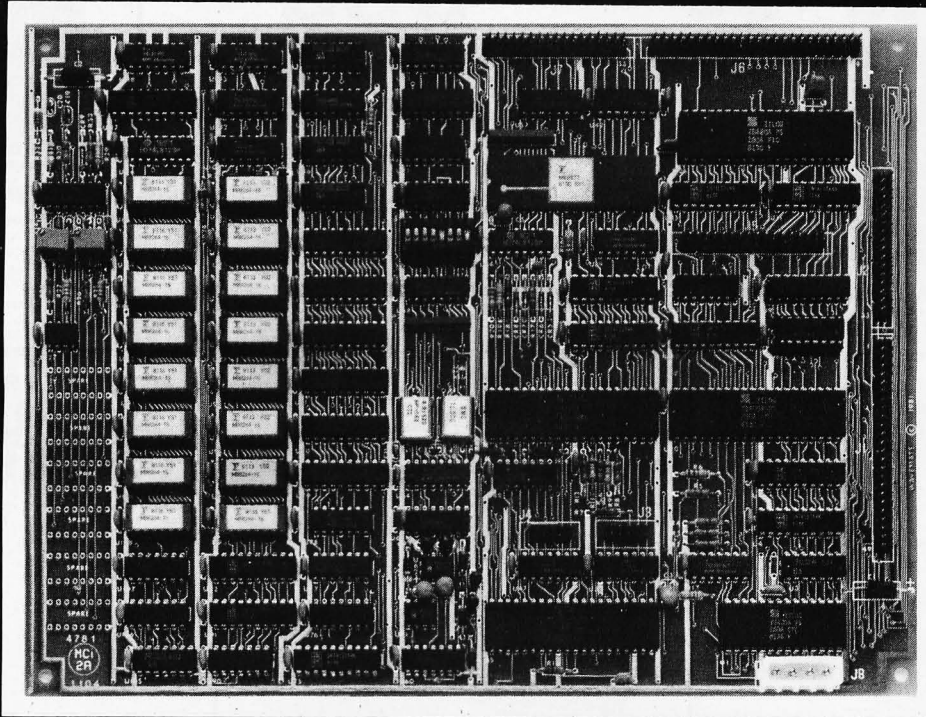
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Circle 201 on Inquiry card.



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- General purpose external DMA I/O
- 2 serial ports with transmission rates to 38.4 K baud with optional DMA operation
- Centronics printer port with optional DMA operation
- Hard disk interface with optional DMA operation
- Vectored interrupts
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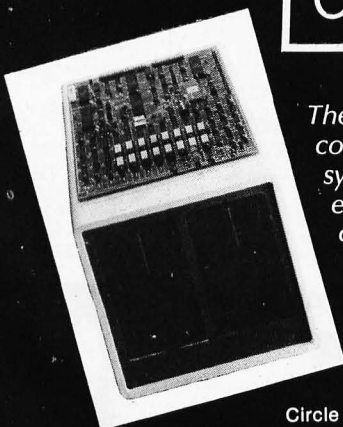
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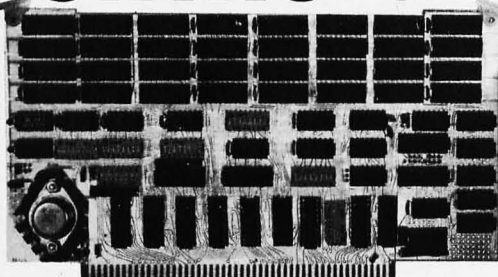




# California Digital

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## California Digital STATIC • 64



RELIABILITY OF STATIC ... PRICE OF DYNAMIC

## Sixteen Bit Memory

# \$595

February Price \$850

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Utilizing the new Hitachi 6167/2167 ram chip, the Static 64 is the most current technology available in S-100 memory products. 24 bit extended addressing, 8 or 16 bit data paths along with 16 bit request and acknowledge make this unique board completely compatible with the IEEE 896 S-100 bus standard.

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### GREEN PHOSPHOR MONITOR

The new Zenith ZVM-121 monitor features a P-31 green phosphor tube along with 15 MHz bandwidth.

Switch selectable for 40 and 80 character per line screen formats.

Accepts composite video and is fully compatible with 80 column Apple cards. VDM-121 20 lbs.



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**\$450**

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Proportional spacing and 132 column compressed print make this low cost machine the best value in today's printer market.



PRINTRONIX P-300

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P-600 **\$6150**

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Epson MX80FT	PREMX80F	595	NEC/Sm 16K	PRN5516ps	2795
Epson MX100	PREMX100		TEC/Starwrit.	PRV300	1395
Anadex 9500	PRA9500	1295	Okidata 80	PRC80	419
Anadex 9501	PRA9501	1295	Okidata 82	PRC82	619
Anacom 150	PRA150	1075	Okidata 83	PRC83	895
IDS Paper Tgr.	PRG460G	1095	Telotype 43K	PTT4320K	1095
IDS Tiger 560	PRG560G	1350	Texas Ins. 810	PRT810B	1450
Diablo 630	PRD630	2150	Tex. Ins 810C	PRT810C	1795
Diablo 1650	PRD1650	2850	Centronics 730	PRC730P	529
Diablo 1640	PRD1640	2496	Centronics 737	PRC737P	595
Datasouth 180	PRD180	1350	Centronics 739	PRC739P	795
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ADDS Regent 40 limited graphics	VDT-R40	1195
ADDS Regent 60 Block mode	VDT-R60	1495
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Digital Equipment VT-100	VDT-V100	1595
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Televideo 912C	VDT-T912	665
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DMA, 4MHz BDC-C2810	\$250
Godbout Z-80 24 bit, 4MHz	239
BDC-C280	
Godbout 8085/8088 dual 16 bit processor BDC-C88	375
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Teletek FDC-1 single board CPU & floppy disk controller BDC-FDC1	695
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TEI 12 slot table ENM-T12	
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VERBATIM	525-01	525-10	NA	26.50
DYSAN	104/1	107/1	NA	39.50

Single Side Double Density

DYSAN	104/1D	107/1D	NA	45.00
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	Double Side Double Density			
SCOTCH	745-0	745-10	745-16	42.50
DYSAN	104/2D	107/2D	NA	49.50
DYSAN 96	204/2D	NA	NA	59.50

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MEMOREX	3060	29.50	MEMOREX	3090	35.00
DYSAN	3740/1	39.50	DYSAN	3740/D	57.50
Thirty Two Sector			Double side Double Density		
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**BSR SYSTEM X-10**

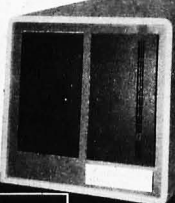
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21L02 1K	1.19	1.09	1.05	.99
2114 300ns.	2.95	2.75	2.50	1.99
4044-4 450ns.	4.50	4.19	4.00	3.75
4044-2 250ns.	4.95	4.65	4.50	4.25
6116 16k 24 pin	7.95	7.50	6.75	6.43
2167/6167 20 pin	11.95	10.75	9.65	9.25

### EPROM

2708 450ns.	3.95	3.50	3.25	3.00
2716 5V.	4.95	4.00	3.75	3.50
2716 tri-volt	8.50	7.95	7.65	7.25
2732 Intel/Pitac.	7.95	7.50	7.00	6.50
2532 Texas Inst	12.95	11.50	10.00	9.50
2764 64K Eprom	29.95	27.00	25.00	23.50



**direct connect MODEM** Your Choice **\$169**

Direct connect modems eliminate loss of information due to the carbon compression associated with acoustic modems. Choose either of these two great units.

The Universal Data Systems 1031P is switch selectable between answer and originate modes. Fully Bell 103 compatible. Directly connects to the new modular telephone jack. 100% powered from the telephone line. No need to locate modem in proximity to A.C. power receptacle. MOD-1031P 2 points.

Novation "D" Cal connects to most of the new "Bell" modular handsets. Ideal for multiple line office telephones. Requires external A.C. power. MOD-DCAT 2 Lb.

## SWITCHES

DIP SWITCHES				TOGGLE			
pos.	ea.	100+	1K+		ea.	100+	
4	.88	.75	.69	7101 on/on	1.19	.98	
7	.99	.83	.79	7103 on/off/on	1.39	1.19	
8	1.05	.91	.87	7107 on/off/on	1.39	1.19	
12	1.19	.99	.91	7108 mut. on	1.39	1.19	
				7205 dupl mut	1.55	1.65	

## CONNECTORS



### GOLD EDGE CONNECTORS

S-100 .125" centers	each	10+	\$2.95
Imstai solder .250" row	each	10+	\$2.50
Imstai wire wrap (TD)	each	10+	3.95
Sullins Hi-Rel. .250"	each	10+	4.50
Sullins Hi-Rel. W/W	each	10+	4.00
Sullins/Altair .140"	each	10+	4.95
.156" Centers (standard)			
22/44 Kim Eyelet	each	10+	2.50
36/72 Digital Group S/T	each	10+	5.95
36/72 Digital Group W/W	each	10+	6.50
43/86 Motorola 6800 S/T	each	10+	5.60
43/86 Moto. 6800 W/W	each	10+	7.00

### INTEGRATED CIRCUIT SOCKETS

Low Profile Wire Wrap	each	100+	\$4.95
8 pin .110 .500	each	100+	\$4.95
14 pin .110 .500	each	100+	\$4.95
16 pin .110 .500	each	100+	\$4.95
18 pin .110 .500	each	100+	\$4.95
24 pin .26 .24	each	100+	\$4.95
40 pin .42 .40	each	100+	\$4.95

### "D" Type

DE9P male	each	10-24	25+	\$1.60	\$1.40	\$1.30
DE9S female	each	10-24	25+	2.25	2.00	1.90
DE hood	each	10-24	25+	1.30	1.25	1.20
DA15P male	each	10-24	25+	2.35	2.15	2.00
DA15S female	each	10-24	25+	3.25	3.10	2.90
DB hood 2/P	each	10-24	25+	1.60	1.35	1.30
DB25P male	each	10-24	25+	2.50	2.35	2.25
DB25S female	each	10-24	25+	3.35	3.15	3.05
DB hood 2/P	each	10-24	25+	1.35	1.15	1.05
DC37P male	each	10-24	25+	4.20	4.00	3.70
DC37S female	each	10-24	25+	6.00	5.75	5.50
DC hood 2/P	each	10-24	25+	2.25	2.00	1.75
DD30P male	each	10-24	25+	5.50	5.10	4.75
DD30S female	each	10-24	25+	9.40	8.60	8.00
DD50 hood 2/P	each	10-24	25+	2.60	2.40	2.10

### CENTRONICS

57-30350	each	10-24	25+	7.95	6.75	5.75
----------	------	-------	-----	------	------	------

### RIBBON CABLE CONNECTORS

17/24 5" disk	each	10-24	25+	4.85	4.15	3.95
20/40 TRS-80	each	10-24	25+	5.65	5.05	4.70
25/50 8" disk	each	10-24	25+	5.90	5.15	4.90



**NEW OLIVETTI 801 \$295**  
Eight Inch Disk Drive

		ONE	TWO	TEN
★ OLIVETTI 801	single	\$319	309	295
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SHUGART 801/R	single	395	385	375
SHUGART 851/R	double	525	495	475
QUME DATA TRACK 8	double	525	495	475

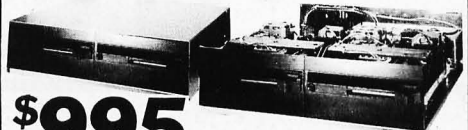
★ The 8" Olivetti drives are approx. 1/2" wider than the Shugarts.

### Five Inch Disk Drives

OLIVETTI 501/400	single	199	185	175
OLIVETTI 502/451	double	235	225	215

Upon request, all drives are supplied with power connectors and one manual per order.

230 volt 50Hz. 8" add \$50.00 per drive.



**\$995** Eight Inch Subsystem

Two Olivetti 801 disk drives with power supply, 4" exhaust fan complete in dual enclosure with all necessary power cables. Documentation included. 50 Lbs. CAL-2801

Signal cable add \$35.00 WCA-6500

Same as above but with:

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Shugart 851R	MSD2851	1450	Qume DT8	MSD8DT	1450

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**Seagate Compatible 7.5 MEGABYTE Winchester Hard Disk Drive**

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## S-100 MOTHER BOARD

**\$35**

IMSAI 18 Slot CAL-M18



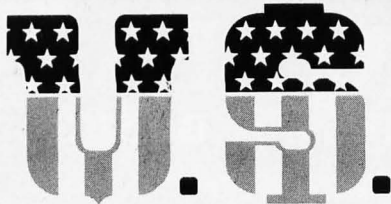
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# 16K Memory

ALL MERCHANDISE 100% GUARANTEED!

4116-200ns **8/15.95**

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			Each	8 pcs
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2708	1024 x 8	(450ns)	2.99	2.75
2758	1024 x 8	(5V) (450ns)	9.95	8.95
TMS2516	2048 x 8	(5V) (450ns)	6.95	5.95
2716	2048 x 8	(5V) (450ns)	5.50	4.95
2716-1	2048 x 8	(5V) (350ns)	9.00	8.50
TMS2716	2048 x 8	(450ns)	9.95	8.95
TMS2532	4096 x 8	(5V) (450ns)	12.95	11.95
2732	4096 x 8	(5V) (450ns) (200ns)	CALL	CALL
2764	8192 x 8	(5V) (450ns)	CALL	CALL

## DYNAMIC RAMS

			100 pcs
4027	4096 x 1	(250ns)	2.50
4116-120	16,384 x 1	(120ns)	8/29.95
4116-150	16,384 x 1	(150ns)	8/18.95
4116-200	16,384 x 1	(200ns)	8/15.95
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21102-4	1024 x 1	(LP) (450ns)	1.29
21102-2	1024 x 1	(LP) (250ns)	1.69
2111	256 x 4	(450ns)	2.99
2112	256 x 4	(450ns)	2.99
2114	1024 x 4	(450ns)	8/16.95
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TMS4044-4	4096 x 1	(450ns)	3.49
TMS4044-3	4096 x 1	(300ns)	3.99
TMS40L44-2	4096 x 1	(LP) (200ns)	4.49
TMM2016	2048 x 8	(200ns) (150ns)	CALL
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LP = LOW POWER

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3.579545	3.95
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5.185	3.95
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6.5536	3.95
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10.0	3.95
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18.0	3.95
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20.0	3.95
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1793	44.95
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TR1602	4.95
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8T97	.99
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74C02	.35	74C901	.80	4020	.95	4099	1.95
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74C14	1.50	74C906	.95	4024	.75	14412	12.95
74C20	.35	74C907	1.00	4025	.35	14419	4.95
74C30	.35	74C908	2.00	4026	1.65	4502	.95
74C32	.50	74C909	2.75	4027	.65	4503	.65
74C42	1.75	74C910	9.95	4028	.80	4508	1.95
74C48	2.10	74C911	10.00	4029	.95	4510	.95
74C73	.65	74C912	10.00	4030	.45	4511	.95
74C74	.85	74C914	1.95	4034	2.95	4512	.95
74C76	.80	74C915	2.00	4035	.85	4514	1.25
74C83	1.95	74C918	2.75	4040	.95	4515	2.25
74C85	1.95	74C920	17.95	4041	1.25	4516	1.55
74C86	.95	74C921	15.95	4042	.75	4518	1.25
74C89	4.50	74C922	5.95	4043	.85	4519	1.25
74C90	1.75	74C923	5.95	4044	.85	4520	1.25
74C93	1.75	74C925	6.75	4046	.95	4522	1.25
74C95	1.75	74C926	7.95	4047	.95	4526	1.25
74C107	1.00	74C927	7.95	4049	.55	4527	1.95
74C150	5.75	74C928	7.95	4050	.55	4528	1.25
74C151	2.25	74C929	19.95	4051	.95	4531	.95
74C154	3.25	74C930	19.95	4053	.95	4532	1.95
74C157	1.75	4000	.35	4060	1.45	4538	1.95
74C160	2.00	4001	.35	4066	.75	4539	1.95
74C161	2.00	4002	.25	4068	.40	4543	2.70
74C162	2.00	4006	.95	4069	.35	4555	.95
76C163	2.00	4007	.29	4070	.35	4556	.95
74C164	2.00	4008	.95	4071	.30	4581	1.95
74C165	2.00	4009	.45	4072	.30	4582	1.95
74C173	2.00	4010	.45	4073	.30	4584	.95
74C174	2.25	4011	.35	4075	.30	4585	.95
74C175	2.25	4012	.25	4076	.95	4702	12.95
74C192	2.25	4013	.45	4078	.30	4724	1.50
74C193	2.25	4014	.95	4081	.30	80C07	.95
74C195	2.25	4015	.95	4082	.30	80C95	.85
74C200	5.75	4016	.45	4085	.95	80C96	.95
74C221	2.25	4017	1.15	4086	.95	80C97	.95
74C373	2.75	4018	.95	4093	.95	80C98	1.20

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14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
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22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39
ST = SOLDER TAIL		
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6845	16.95
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6862	11.95
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7815T	.99	7924T	1.19
7824T	.99		
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78L12	.69	79L15	.79
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7403	.19	7460	.23	74143	2.95	74192	.79
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7405	.22	7472	.29	74145	.60	74194	.85
7406	.22	7473	.34	74147	1.75	74195	.85
7407	.22	7474	.35	74148	1.20	74196	.79
7408	.24	7475	.49	74150	1.35	74197	.75
7409	.19	7476	.35	74151	.65	74198	1.35
7410	.19	7480	.59	74152	.65	74199	1.35
7411	.25	7481	1.10	74153	.55	74221	1.35
7412	.30	7482	.95	74154	1.40	74246	1.35
7413	.35	7483	.50	74155	.75	74247	1.25
7414	.55	7485	.65	74156	.65	74248	1.85
7416	.25	7486	.35	74157	.55	74249	1.95
7417	.25	7489	4.95	74159	1.65	74251	.75
7420	.19	7490	.35	74160	.85	74259	2.25
7421	.35	7491	.40	74161	.70	74265	1.35
7422	.29	7492	.50	74162	.85	74273	1.95
7423	.29	7493	.49	74163	.85	74276	1.25
7425	.29	7494	.65	74164	.85	74279	.75
7426	.29	7495	.55	74165	.85	74283	2.00
7427	.29	7496	.70	74166	1.00	74284	3.75
7428	.45	7497	2.75	74167	2.95	74285	3.75
7430	.19	74100	1.00	74170	1.65	74290	.95
7432	.29	74107	.30	74172	5.95	74293	.75
7433	.45	74109	.45	74173	.75	74298	.85
7437	.29	74110	.45	74174	.89	74351	2.25
7438	.29	74111	.55	74175	.89	74365	.65
7440	.19	74116	1.55	74176	.89	74366	.65
7442	.49	74120	1.20	74177	.75	74367	.65
7443	.65	74121	.29	74178	1.15	74368	.65
7444	.69	74122	.45	74179	1.75	74376	2.20
7445	.69	74123	.55	74180	.75	74390	1.75
7446	.59	74125	.45	74181	2.25	74393	1.35
7447	.69	74126	.45	74182	.75	74425	3.15
7448	.69	74128	.55	74184	2.00	74426	.85
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74S64	.79	74S161	2.85	74S251	1.90	74S482	15.60
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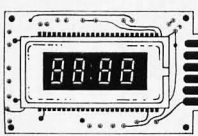
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**12VDC AUTOMOTIVE/INSTRUMENT CLOCK**

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Features: Bright 0.3" green display. Internal crystal time base. ±0.5 sec./day accur. Auto display brightness control. Display color filterable to blue, blue-green, green & yellow. Complete—just add switches and lens.

**MA1003 Module (3.05" Lx1.75" Hx.98" D) \$16.95**

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### STATIC RAMS

MM2114N-24K (200NS)	\$2.49 each (8 each \$19.95/lot) (100 each \$195.95/lot)
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## EPROM Erasing Lamp

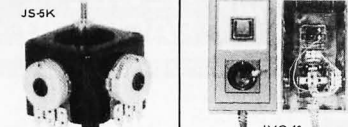


- Erasers 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erasures up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch.
- Special conductive foam liner eliminates static build-up.
- Built-in safety lock to prevent UV exposure.
- Compact—only 7 7/8" x 2 7/8" x 2".
- Complete with holding tray for 4 chips.

UVS-11EL Replacement Bulb \$16.95

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The dependable, low cost, largest selling fan for commercial cooling applications.

- 105cmm free air delivery
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- acoustical rating as low as NC-38
- Built-in fan guard, 10 min. duty at 10°C
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- for ambient to 70°C
- UL yellow card recognized & CSA approved

Model No. MU2A1, Part No. 02821, Bearing—Sleeve, 115V, 50/60Hz, 14 Watts, 105cmm

**MU2A1 \$9.95 ea.**

## JE215 Adjustable Dual Power Supply



General Description: The JE215 is a Dual Power Supply with independent adjustable positive and negative output voltages. A separate adjustment for each of the supplies provides the user unlimited applications for IC current voltage requirements. The supply can also be used as a general all-purpose variable power supply.

**FEATURES:**

- Adjustable regulated power supplies, pos. and neg., 1.2VDC to 15VDC.
- Power Output (each supply): 5VDC @ 500mA, 10VDC @ 750mA, 12VDC @ 500mA, and 15VDC @ 175mA.
- Two, 3-terminal adj. IC regulators with thermal overload protection.
- Heat sink regulator cooling.
- LED "on" to 100mA.
- Printed Board Construction.
- 120VAC input.
- Size: 3 1/2" W x 5 1/16" L x 2 1/8" H.

**JE215 Adj. Dual Power Supply Kit (as shown) \$24.95**

(Picture not shown but similar in construction to above)

JE200 Reg. Power Supply Kit (5VDC, 1 amp)	\$14.95
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### 6800/6800 SUPPORT DEVICES

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MM5509-H Dual 256-Bit Dynamic	1.95
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MM5511-H Dual 64-Bit Dynamic	1.95
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LM338Z Constant Current Source	1.30
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### EECO Rocker Dip Switch — "Mini-Dip™" 2400 Series

THE MOST UNIQUE DIP SWITCH AVAILABLE!

MINI-DIP is designed to retrofit all major brands of Dip switches. Unique features include locking rod design to prevent accidental opening and gold-silver-wiping contact. One-piece housing and press-fit terminals prevent contamination. 2-10 station Form "A" and 1-5 station Form "C".

• Terminals on .100 x .300 (.254 x 1.62) centers • PCB or dip socket mountable • Positive clamping/wiping action with gold contact • Total seal and bottom seal

Part No.	Pos.	Configuration	Socket	Part No.	Pos.	Configuration	Socket	Price
2400-10	2	12	8 pin	2400-6	6	123456	14 pin	1.09 - 10/9.95
2400-2	2	12	8 pin	2400-7	7	1234567	14 pin	1.19 - 10/10.95
2400-3	3	123	8 pin	2400-8	8	12345678	16 pin	1.29 - 10/11.95
2400-4	4	1234	8 pin	2400-9	9	123456789	18 pin	1.39 - 10/12.95
2400-5	5	12345	14 pin	2400-10	10	123456789	20 pin	1.49 - 10/13.95

### JE608 PROGRAMMER 2704/2708 EPROM PROGRAMMER

GENERAL APPLICATIONS:

- To program EPROMs 2704 and 2708.
- Developmental system for microcomputer circuits.
- To read the contents of a pre-programmed EPROM.
- To compare EPROMs for content differences.
- To emulate a programmed EPROM.
- To store program in RAMS for alterations.
- Three separate Display Registers: 8 LED's for Hex Key entries, 10 LED's (2x5) for Address Register and 8 LED's for Data Memory Register.
- The Data Memory Register displays the content of the RAMs from the EPROM chip. Development of microprocessor systems by means of a ribbon cable from the programmer panel test socket to the EPROM socket on the microprocessor board. Rapid checking of program data.
- LED's indicate program data.
- Write into RAM's with keyboard entries. Allows manual stepping manipulation (up and down) at any address location.
- Stand-alone EPROM Programmer consisting of a 19-key Hexadecimal Keyboard assembly, Programmer Board assembly, 4 power supplies and a 19-key Hexadecimal Keyboard assembly.
- The Kit Socket is zero force insertion type. Power requirements: 115VAC, 60Hz, 6W. Compact desk-top enclosure. Color-coordinated design's case with light tan panels and molded pieces in black.

Size: 3 1/4" H x 11" W

The JE608 EPROM Programmer is a completely self-contained unit which is independent of computer control and requires no additional systems for its operations. The EPROM can be programmed from the Hexadecimal Keyboard or from a pre-programmed EPROM. The JE608 Programmer can emulate a programmed EPROM by the use of its internal RAM circuits. This will allow the user to test a program for a system, prior to programming a chip. Any changes in the program can be entered directly into the memory circuit with the Hexadecimal Keyboard so that rewriting the entire program will not be necessary. The JE608 Programmer contains a Programmer Board w/28 IC's in the JE608 Programmer.

±5V, ±12V and ±26V. The Hexadecimal Keyboard and LED Test Socket Panel board are separate assemblies within the system.

**JE608K Kit \$399.95**

**JE608A Assembled and Tested \$499.95**

### JE608-16K ADAPTER BOARD FOR 2716/2758 EPROMS

GENERAL DESCRIPTION:

The JE608-16K Adapter Board allows the JE608 Programmer to be modified for the additional programming of the 2716 and 2758 EPROMs. The adapter provides for adding an address switch for the 2716 and also for selecting the proper power and timing pulses to be applied to the EPROM. Programming and emulating the 2716 (16K) EPROM is done separately to each JE608-16K.

**JE608-16K Adapter Board Kit \$29.95**

**JE608-Upgrade (Send assembled JE608 to factory for adapter installation) \$99.95**

**JE608A-16K Mod. Assembled JE608 w/Adapter (JE608-16K) Installed \$599.95**

**\$10.00 Minimum Order — U.S. Funds Only**

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**3/82**

### DATA ACQUISITION (CONTINUED)

AD6080ALCN 8-Bit A/D Converter (8-Ch. Multi.)	5.25
AD6080ALCN 8-Bit A/D Converter (8-Ch. Multi.)	10.95
DAC1000LCN 10-Bit D/A Conv. Micro. Comp. (0.05%)	13.95
DAC1008LCN 10-Bit D/A Conv. Micro. Comp. (0.05%)	8.95
DAC1008LCN 10-Bit D/A Conv. Micro. Comp. (0.05%)	8.95
DAC1008LCN 10-Bit D/A Converter (0.05% Lin.)	5.95
DAC1008LCN 10-Bit D/A Converter (0.05% Lin.)	5.95
DAC1008LCN 10-Bit D/A Converter (0.05% Lin.)	5.95
CD4051 16-Channel Multiplexer	1.19
AV-5101 30K BAUD UART	6.95

### RAM'S

1101 256K Static	1.49
1102 256K Static	1.49
2101 (8101) 1024K Static	3.95
2102 1024K Static	1.75
2110 1024K Static	1.95
2111 (8111) 256K Static	3.95
2112 256K Static MOS	4.95
2114 1024K Static 40nm	2



# ADVANCED COMPUTER PRODUCTS

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**apple computer**  
Sales and Service

COMPUTERS	LIST	ACP
Apple II 16K	\$1330.00	\$1029.00
Apple II 48K	1530.00	1099.00
Apple II 64K	1729.00	1225.00
Apple II 64K	2519.00	1775.00
w/280 Softcard & Vision 80		
Apple III 128K	3495.00	2895.00

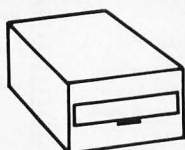
APPLE HARDWARE	LIST	ACP
Apple Disk II w/interf.	\$ 645.00	\$ 529.00
Apple Disk II w/o	525.00	449.00
Silentype Printer	395.00	355.00
Prototype Card	24.00	21.95
IEEE-488 Interface	450.00	375.00
1 year ext. warranty	225.00	175.00
Parallel Printer Interface	180.00	159.95
Communications Card	225.00	189.00
Pascal Language System	495.00	425.95
High Speed Serial Interface	195.00	174.95
Applesoft II ROM Card	200.00	159.95
Language Card	195.00	174.95
12" Green Monitor III	320.00	275.00
Profile Hard Disk Subsystem	3495.00	2995.00
Graphics Tablet	795.00	695.00

APPLE COMPATIBLE HARDWARE	LIST	ACP
Microsoft 280 Softcard	\$299.00	
Microsoft 16K RAMcard	169.00	
SSM AIO Serial/Parallel	165.00	
The Keyboard Company	45.00	
Joystick	119.00	
Numeric Pad	169.00	
Mountain Computer	159.00	
ROMplus	159.00	
ROM Writer	call	
RAMPlus	229.00	
CPS Multifunction	699.00	
Expansion Chassis	125.00	
Thunderclock	49.00	
X-10 option	29.00	
Pascal option	139.00	
CCS Serial I/O	99.00	
Parallel I/O	99.00	
M & R Enterprises	45.00	
Apple Fan	29.95	
Sup'R Mod	199.00	
Aux Switcher Supply	299.00	
Sup'R Term	299.00	
ALS Smarterm	299.00	
Corvus	299.00	
5MB Hard Disk	4325.00	
10Mb	5240.00	
20Mb	5240.00	
Apple 16K Upgrade Kit	15.95	
Votrax Voice Box	call	
Scott Voice Recognition	849.00	

APPLE SOFTWARE	LIST	ACP
Visicalc	\$ 169.00	
SuperCalc	199.00	
Visi-Trend/VisiPlot	239.00	
VisiDex	169.00	
VisiTerm	129.00	
BPI General Ledger	329.00	
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Data Star	199.00	
Spell Star	169.00	
VTS-80 CPM	319.00	
Fortran 80	195.00	
Cobol 80	699.00	
PFS Filing System	75.00	
PFS Report	75.00	

## FLOPPY DISK DRIVES QUME DT/8 D/D D/S

QUME DT/8 D/D D/S	LIST	ACP
Tandon TM100-1 5 1/4" Disk Drive	\$ 569.95	
MPI BS-1 5 1/4" 40 tracks	279.00	
Shugart SA400-5 1/4" 35 tracks	295.00	
Shugart 800/801R 8"	449.00	
Siemens Shugart Compatible Model FDD-120-8D	429.00	
PERSCI Model 277 Dual	1195.00	
MPI BS2 5 1/4" Dual	349.00	
WANGO/SIEMENS 2	290.00	
MPI 91 Double Track Density Single Side	375.00	
80 Tracks		
MPI 92 Double Track Density Double Side	475.00	
160 Track		



**Vista**

## VISTA COMPUTER

Vision 80 80x24 display card	LIST	ACP
Vision 40 40 col. enhancement	\$395.00	\$299.00
Vision 20 lower case ROM	199.00	149.00
A800 8" D/D FDC	595.00	499.00
MM9 9 voice music	195.00	99.00
GB75 IBM Regent/Apple I/O	195.00	169.00
PDS PROM development	595.00	399.00
TYPE AHEAD BUFFER	49.95	35.00



## VISTAV-DRIVE

VISTA V-DRIVE	LIST	ACP
Model V-1000 8" floppy disk enclosures with Qume Datalink 8		
CABINET	\$ 459.95	
w/2 single-sided drives, ps&c	\$1495.00	
w/2 double-sided drives, ps&c	\$1495.00	
A800 Double density controller (for Apple computers)	\$ 499.00	

## VISTA V 80

MINI DISK DRIVE	LIST	ACP
V 80 Single drive, case ps	\$299.00	
V 80 Dual drive, case, ps	\$599.00	
D/S, D/D also available		

## APPLE COMPATIBLE DRIVES (MicroSci)

A2 series is plug-compatible	LIST	ACP
Save \$300 on dual drive system		
DOS software not included		
A2 5 1/4" 143K Drive	\$479.00	\$389.00
A2C controller	100.00	89.00
A405 1/4" 160K Drive	449.00	365.00
A70 5 1/4" 286K Drive	599.00	480.00
A40C controller for A40 A70	100.00	79.00

## DISKETTES

Verbatim SS5D 5 1/4"	per box	\$ 24.95
Maxell SS5D 5 1/4"	per box	29.95
Top Quality Private Label SS5D 5 1/4"	per box	19.95
8" per box	29.95	



## ROBOTIC ARM

Microbot Minimover-S	LIST	ACP
Completely Assembled w/Applications Manual	\$1695.00	
ARMBASIC Software For TRS-80	39.95	
Application/Reference Manual	16.95	

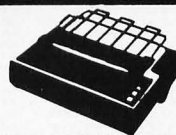


## HEWLETT PACKARD

## CALCULATORS

HP-41CV w/2.2K memory	NEW!	325.00	256.00
HP-41C Calculator		250.00	189.95
Memory Module for 41C			26.00
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Printer for 41C, CV		385.00	291.95
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HP-11C Advanced Scientific	★ NEW!	135.00	149.95
HP-12C Financial		150.00	129.95
HP-34C Prog. Scientific		150.00	119.00
HP-38C Prog. Business		150.00	119.00
HP-97 Programmable Printer		750.00	595.00

NOTE: WE STOCK ACCESSORIES



## PRINTERS

### EPSON-VISTA

	LIST	ACP
MX-80 Dot Matrix	\$645.00	\$429.00
MX-80 FT	745.00	529.00
MX-100	999.00	725.00
Apple I/O & cabl	110.00	89.00
Graftrax option	95.00	89.00
IEEE I/O & cable	130.00	95.00
Serial I/O & cable	130.00	95.00
Serial w/2K & cable	175.00	149.00
Universal Graphics Utility	39.95	35.95

NEC

### NEC

8023 Dot Matrix	795.00	649.00
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### DIABLO

630 Daisywheel	2965.00	2295.00
Tractor	249.00	169.95

### C. ITOH/VISTA

Starwriter V300	25 cps	1895.00	1495.00
	45 cps	2195.00	1795.00
	100 cps	749.00	675.00

### ANADEX

9500/9501	1650.00	1350.00
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### QUME

9-45	3295.00	2995.00
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### IDS

460G w/graphics	1395.00	899.00
560G 14.75" carriage	1695.00	1199.00



## TERMINALS

### TELEVIDEO

910	\$ 699 00	\$ 599 0
912C	950 00	699 0
920C	995 00	799 0
950C	1195 00	999 0

### SOROC

IQ120	699.00	
IQ135	899.00	
IQ140	1149.00	



## MONITORS

### SANYO

SANYO	LIST	ACP
9" B&W	\$235 00	\$169 95
9" Green	259 00	199 95
12" B&W	340 00	249 00
12" Green	360 00	279 00
13" Color	550 00	429 00
13" RGB	1195 00	995 00



## MODEMS

### NOVATION

	LIST	ACP
Cat	\$199 95	\$149 00
D-Cat	199 95	169 00
Apple-Cat	349 95	309 00
Auto-Cat	299 95	239 95

### HAYES

Macromodem	\$379.00	\$299.00
Smartmodem	279.00	249.00

### ROTRON MUFFIN FAN

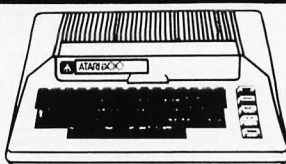
115 VAC 7 watts WR2A1	\$13.95	
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## IBM COMPATIBLE BOARDS

Top Quality 1 year warranty

	LIST	ACP
256K Add-on memory	\$1145 00	\$899 00
PC Communications	295 00	269 00
Graphics		call
Wire Wrap kit w/extender	95 00	89 00



**ATARI**

## ATARI COMPUTER

	LIST	ACP
400 w/16K RAM	\$399.00	\$339.95
400 Basic Language Module	49.00	47.00
800 w/16K RAM	899.00	699.00
410 Prog Recorder	90.00	80.00
825 Printer	799.95	699.00
830 Acoustic Modem	199.95	159.00
850 Interface Module	219.95	189.95
MTK 16K RAM	99.50	84.00
MTK 32K RAM	199.50	139.00
ATARI VisiCalc	200.00	160.00
ATARI Pac-Man	44.95	36.95

## ATARI "THE COMMUNICATOR" Kit

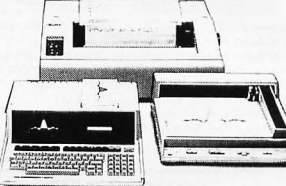
Package Deal	Source Pkg	LIST	ACP
850 I/O		\$299.00	\$249.00
830 Modem	Dow Jones Pkg	379.00	319.00
Teletink 1	Compuserve Pkg	200.00	169.95
Total Value \$444.85			\$379.95

## XEROX 820

### "The Personal Computer"

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w/purchase A/R G.L.A.P. Payroll Inventory  
\$1100.00 VALUE 8" only

		LIST	ACP
820-1	5 1/4" system	\$2995.00	\$2496.00
820-2	8" system	3795.00	★ 3195.00
CP/M		200.00	169.95
SuperCalc		295.00	239.95
Word Processing		500.00	429.95



## HEWLETT-PACKARD COMPUTERS

HEWLETT-PACKARD COMPUTERS		
	LIST	AC
HP-125 CPM Microcomputer	\$3750.00	\$3090.00
HP-85 Microcomputer	2750.00	2375.00
HP-83 Microcomputer	2250.00	1899.00
82903A 16K Memory Module	195.00	174.95
7225 Graphics Plotter	2450.00	2125.00
7225 Personality Module	750.00	675.00
HP-125080 8" Disk	1210.00	1085.00
HP-9895A 8" Disk	6850.00	5750.00
HP-9111A Graphics Tablet	2050.00	1790.00

## SINGLEBOARD COMPUTERS

ROCKWELL	
AIM 65 w/1K	\$435.00
AIM 65 w/4K	475.00
8K BASIC ROM	99.00
4K Assembler ROM	84.00
Power Supply	64.95
Enclosure	49.95
Total system w/4K	669.00

### SYNERTEK

SYM-1	239.00	
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### SD SYSTEMS

Z80 Starter Kit	367.00	
Z80 Starter A & T	450.00	
SBC 100 A & T	367.00	
SBC 200 A & T	399.00	

### RCA

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LIST	ACP
#1 Best seller	\$645.00



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TECH 310 Digital Multimeter	140.00
CH330 Digital Multimeter	189.00
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DC-202 Deluxe Carrying Case	24.00
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RP-221 RP Probe	35.00
CT-231 AC Current Clamp	42.00
DL-241 Deluxe Test Lead Kit	10.00
TL-242 Square Test Leads	6.00

### NLS TOUCH TEST 20

Digital Multimeter	\$349.95
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### \$100 32K STATIC RAM BOARD

2 or 4 MHz Expandable uses 2114L's

16K 4 MHz Kit	\$159.95
16K 4MHz ASK	217.95
32K 4MHz Kit	289.95
32K 4 MHz ASK	339.00
Bare Board	39.95
Bare Bd w/alt parts less mem.	99.95

### 8080/8085 SUPPORT

8155/8156 I/O	\$ 11.95
8755 I/O w/EPROM	44.95
8202 Dyn. RAM Cont.	34.95
8205/74S 138 Decoder	3.95
8212 8 bit I/O	2.75
8214 Priority Int.	2.75
8216 Bus Driver	2.75
8224 Clock Gen.	2.95
8224 4 MHz	2.95
8226 Bus Driver	2.95
8726 Bus Driver	2.95
8228 Sys. Con.	4.50
8238 Sys. Con.	5.50
8243 I/O Exp.	9.50
8250 Async. Com.	15.95
8251 Prog. I/O	6.95
8253 Int. Timer	12.95
8255 Prog. I/O	4.75
8257 Prog. DMA	9.95
8259 Prog. Int.	9.95
8275 CRT Con.	29.95
8279 Prog. Keyboard	9.95

### Z80 SUPPORT

Z80-PIO	2.5 MHz	\$ 6.75
Z80-PIO	4.0 MHz	9.95
Z80-CTC	2.5 MHz	5.75
Z80-CTC	4.0 MHz	3.95
Z80-DMA	2.5 MHz	19.95
Z80-DMA	4.0 MHz	29.95
Z80-SIO-0	2.5 MHz	24.95
Z80-SIO-0	4.0 MHz	29.95
Z80-SIO-1	2.5 MHz	24.95
Z80-SIO-1	4.0 MHz	29.95
Z80-SIO-2	2.5 MHz	24.95
Z80-SIO-2	4.0 MHz	29.95

### 4K STATIC RAM SELL-OFF

for Z80 based systems

★ Zilog 6104 4 4Kx1 450ns ★ \$14.95

### PROTO BOARDS

PB-6	\$ 18.95
PB-100	21.00
PB-101	28.00
PB-102	34.00
PB-103	59.00
PB-104	77.00
PB-203	130.00
PB-203A	170.00
PB-203A Kit	140.00

### PROTO CLIPS

PC-14	14 Pin	\$ 3.25
PC-16	16 Pin	3.50
PC-24	24 Pin	8.50
PC-40	40 Pin	13.95

### 6800 SUPPORT

6810 128x8 RAM	\$ 4.75
6820	6.50
6821	6.50
6828 Priority Int.	10.50
6834 1 512x8 Eprom	16.95
6845/HD6553 CRT Cont.	29.95
6847 Color CRT	29.95
6850 ACIA	5.95
6852 Serial Adapter	5.95
6860 Modem	10.95
6862 Modulator	11.95
6871A 10MHz OSC	25.95
6880 Bus Driver	2.19
MC68488	19.95
68047	24.95

### 6502 SUPPORT

6520 PIA	\$ 7.50
6522 Mult.	11.95
6530-002 003 004 005	21.95
6532	19.95
6551	19.95

### BIPOLAR PROMS

87523 6330/5600/74S188	\$ 4.25
875115 (512x8) TS	12.95
875123 5610/74S288 (32x8) TS	4.25
875126 5603/74S387 (256x4) OC	4.25
875129 5629/74S287 (256x4) TS	4.25
875130 5604/74S570 (512x4) OC	6.50
875131 74S571 (512x4) TS	6.95
875137 74S573 (1024x4) TS	12.95
875141 3624/74S474 (512x8) TS	12.95
875147 74S472 (512x8) TS	12.95
74S471 6309 (256x8) TS	7.95

### MOS PROMS

2764 (8Kx8) TS	\$89.95
2732 (4Kx8) TS	16.95
2716 2516 5V (2Kx8) TS	8.95
1M52716 15V 12V	17.95
2758 5V (450ns)	7.50
2708 (450ns)	5.75
2708 (650ns)	5.25
1702A	5.75
MM5203AQ	14.50
MM5204Q	9.95

### IC SPECIAL PURCHASE

82509 64x9 RAM	\$ 8.95
DP8304 Octal Driver	2.95
DAC80EX D/A Conv.	1.95
MC1650 H-Speed A/D	7.95
SN75136	46
MC10210	79
LM339	79
LM710CN	29
LM711CN	29
78M06	49
79M06	49
74157	49
74161	49
74C74	39
MC14433P 3.5 Digit A/D	13.95
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LM1850N Gr. Fault	3 for 100
LM2902N Quad Amp	2 for 100
LM2917N Freq. to Volt. Conv.	2 for 199
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27508 32x8 PROM (IM5600)	2.95
ULN2003A 7ch. dr.	99
MCM14505 64 bit St. RAM	6.95
MC01003 Opto Cap. (4N28)	3 for 100
SPX33 Opto Coup.	3 for 100
HS045 CMOS Slow DPST	4.50
UA3045 Trans. Array	1.25
TR1402A UART	1.95
MM1007 Dyn. Mem. Shift Reg.	3.95
3318 TV Ch. Disp. Circuit	4.50
820K C.J. 8 bit A/D	9.95
7520/25	50
1488/1489	2 for 199
MC1372	8.95
MM5298-4A B	2.95
LM377	1.25
LM380	1.25
LM387	1.25
LM4558	3 for 199
RC4136	2 for 199
RC4131	2 for 199
COM-5027	39.95
COM-5037	49.95
TMS 4060 4K RAM (22 Pin)	1.49
TMS 4044 4K RAM (18 Pin)	1.49
MCM 6604 4K RAM (16 Pin)	1.49

### DYNAMIC RAM

416 4116 16K (16 Pin)	\$ 2.49
416 200 ns Set of 8	15.95
4115 8K (16 Pin)	2.49
4050 4Kx1 (16 Pin)	4.95
4060 4Kx1 (22 Pin)	4.95
4044 4Kx1 (16 Pin)	3.95
2104 4Kx1 (16 Pin)	4.75
4027 4Kx1 (16 Pin) UPD 414	4.95
5261	1.95
5262	1.95
5270	4.95
5280	4.95
1103	95
4008L	4.95
6605	7.95
6604	4.95
6602	1.50
64K RAM	9.95

### MICROPROCESSORS

Z8001 16 bit to 8MHz	\$ 110.00
Z8002 16 bit to 64K	75.00
Z800	9.95
Z80A	11.95
F-8 (3850)	16.95
2650	16.95
CD1802	9.75
8080A	4.75
8080A-4MHz	19.95
8085	14.95
8008-1	14.95
2901	9.90
2901A	14.95
TMS 9900JL	49.95
6502	9.95
6502A	16.95
IM6100	29.95
6800	11.75
6800B 2.0 MHz	19.95
6802P	14.95
8035	14.95
8039	12.95
INS 8073N	34.95
8755	49.95
8748	49.95
6809	30.00
8086	49.95
68000	129.95

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2513-001 (5V) Upper	\$ 9.50
2513-005 (5V) Lower	10.95
2513-ADN3 (5V) Lower	14.95
MCM667 10 Asc. Shifted	12.95
MCM66740 Math Symbol	13.95
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### CONNECTORS (GOLD)

DB25P (RS232)	\$ 3.25
DB25S Female	3.75
Hood	1.25
Set w/Hood Sale	7.50
22 44 W.W. S.T. KIM	5.95
43 86 W.W. S.T. MOT	6.50
50 100 S-100 Connector w/w	4.95
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S-100 Sound Board	\$ 34.95
8080A CPU	34.95
32K Static RAM (2114)	34.95
8K Eprom (2708)	24.95
2708 2716 Eprom	34.95
ACP Proto Bd	22.20
Vector 8800 Proto	29.95
Vector 8803 11 slot Mb	18.95
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13 Slot Mother Board (WMC)	29.95
9 Slot Mother Board (WMC)	34.95
Floppy Mother (E expandable)	39.95
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Apple Sound Bd	24.95

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Holds 5 EPROMs at a time  
★ Model S-527 ★ \$325.00

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for Apple/TRS-80

★ 8 pcs 4116 16Kx20 250ns Specifically configured for use ★ \$15.95

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Prime 450 ns  
8 29 95  
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2732 SALE \$8 69 95

### NEW! from Zilog

★ Z-8 CPU w/ Tiny Basic & debug program  
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21102 250ns	1.59	1.55	1.15
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114L (450ns)	3.75	3.50	3.25
2114L 250ns (4045)	6.50	5.95	5.50
2114L-450ns (4045)	4.75	4.25	3.95
4044 250ns	8.95	7.50	6.90
4044 450ns	5.95	5.95	4.75
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EMM4402	7.95	7.25	6.25
AMD1940-1	10.95	10.25	9.25
AMD1901-31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125-93425 (45ns)	9.95	8.35	8.25
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2147 Low Power 4 K Static	9.95	8.95	7.95
53415	9.95	8.95	8.50

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16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	110
24	38	85	120
28	43	110	149
36	58	125	159
40	60	140	189

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1781 Dual Floppy	26.95
1791-01 Dual Floppy	36.95
1791-02 Dual Floppy	44.95
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CTS206-4	1.75	CTS206-8	1.95
CTS206-5	1.75	CTS206-9	1.95
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# Unclassified Ads

**FOR SALE:** BYTE, May 1978 through May 1981 (37 issues). Kilobaud Microcomputing, #11 through #29 and #37 through #54 (37 issues). Creative Computing, January 1978 through July 1981 (34 issues). onComputing, Summer 1979 through Spring 1981 (8 issues). Each issue for \$1.75 or all of them for \$150. I will pay postage. Joe, 3503 Berkeley Pl. NE, Albuquerque, NM 87106, (505) 266-2344.

**FOR SALE:** 16-column calculator printer. Works, but little documentation. \$25 plus shipping (5 pounds). Hex keypad and display, obviously homemade. \$20. Fifty Tri-state bipolar ROMs that decode and drive eight S-100 signals directly from Z80. No external buffering necessary. Derives sMEMR, MWRT, sINP, sOUT, pSYNC, INTA, sW/O, and pW/R. \$6 each. Mark Derthick, 7 Fraternity Row, St. Louis, MO 63130, (314) 721-9093.

**FOR SALE:** Heath H-89 all-in-one microcomputer. Built in July 1981. Floppy-disk drive, 48 K programmable memory, cassette interface, HDOS 2.0 DOS, Microsoft and BH BASIC, 15 disks of club programs, and all documentation. \$3000 value for \$1700. Also have Heath ET-3400 trainer, EE-3401 microprocessor self-instruction course, and final exam; \$195. Will pay shipping in U.S. Gary Bagby, 2520 Childs Rd., Omaha, NE 68147, (402) 731-1871.

**FOR SALE:** Ohio Scientific Challenger III (Model C3-S1) with three processors (6502A, 68B00, Z80A) and 56 K memory. Double-sided 8-inch floppies for 1.2 megabytes storage. CP/M operating system with FORTRAN and COBOL compilers. Manuals and documentation included. \$4800. Ron Hopson, POB 7929 (N173), Philadelphia, PA 19101.

**FOR SALE:** Interac computer—not used, still in the package. With 16 K RAM, 2 K ROM, cassette, 1500 bps, eight colors, and sound; \$284. Write for more details. Steve Buhk, 109 East Kentucky Ave., Deland, FL 32720.

**FOR SALE:** Centronics 730 printer, same as Radio Shack Lineprinter II. New, only tested. Full documentation. Extra ribbons. \$600 UPS COD. D. Dingley, 417 Liberty St., Painesville, OH 44077, (216) 354-5759.

**FOR SALE:** SSM CB1A 8080 S-100 processor board with 1 K RAM, 2 K video monitor in ROM, and parallel I/O port. Assembled and tested. Virtually unused. \$125. Craig Cline, 40 Creighton St., Cambridge, MA 02140, (617) 661-3966.

**FOR SALE:** Linear programming package for Hewlett-Packard 9825 computer. Complete package consisting of manual and three cartridges in binder. Originally cost \$450 and used only a couple of times. Will sell for \$125 or exchange for HP-85 software. I don't have. Will also consider HP-85 ROMs. C.J. Kanak, POB 28206, Tempe, AZ 85282, (602) 968-6542.

**FOR SALE:** Apple II with 64 K Pascal language system, two disk drives, software, and other accessories; \$2000. Zenith Z19 terminal; \$600. Heath H-14 printer, assembled; \$500. All items in good working order. Thomas McDonnell, 1738 Orchard Dr., Canton, MI 48188, (313) 326-3047 weekends or after 6 p.m. weekdays.

**FOR SALE:** Texas Instruments TI-745. Like new. Under constant maintenance by TI. Must sell. Asking \$1000 or best offer. D.P. Apt, 25102 Friar Lane, Southfield, MI 48034.

**FOR SALE:** TEC V-300 daisy-wheel printer. Brand new. Bidirectional printing at 25 cps/136 print positions wide. Proportional spacing: 1/20-inch horizontal and 1/48-inch vertical. Centronics parallel interface. Listed at \$1595; will sell for \$1000 FOB. R.G. Lathrop, 810 Rush Court, Chico, CA 95926, (916) 343-7098.

**FOR SALE OR SWAP:** TRS-80 4 K Color Computer, pair of joysticks, and three cartridges of games. Will send in original carton via U.P.S. \$325 or will swap for a Model I mini-disk drive. Jack Liskey, 360 Mae Rd., Glen Burnie, MD 21061.

## Ciarcia Wins BOMB by Remote Control

Steve Ciarcia's project on using your computer for remote control earned him first place in the December BOMB contest. Now if we could only send him the \$100 cash prize by remote control. Senior editor Gregg Williams took second place with his photo essay, "The Coinless Arcade." Though Gregg is a gamesman, he's not a gambler and when playing video games he can't afford to lose because as a staff member he is ineligible for the second-place \$50 prize. Third place went to William Barden Jr.'s "Color Computer from A to D, Make Your Color Computer 'See' and 'Feel' Better," the first installment in a series devoted to Radio Shack's TRS-80 Model I, Model III, and Color Computer.

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## BOMB

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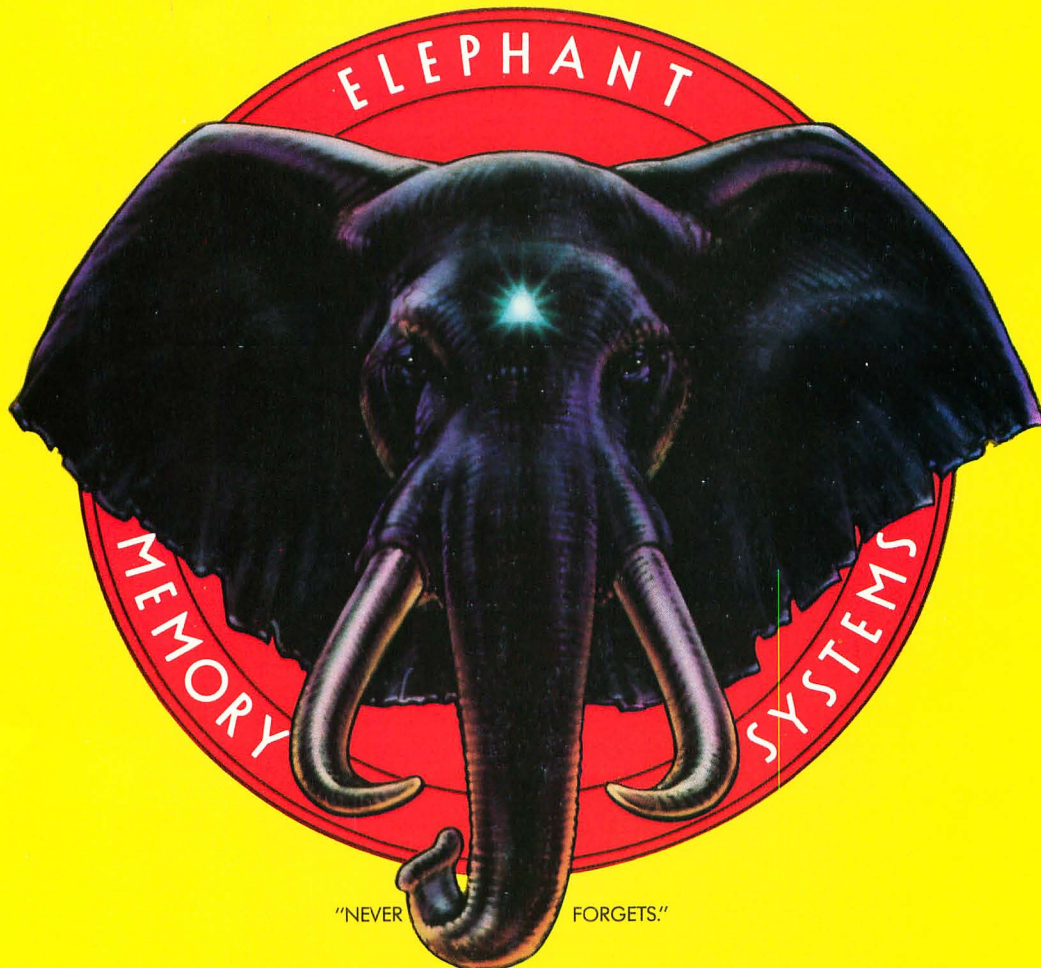
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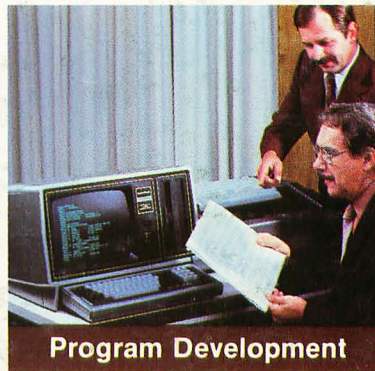
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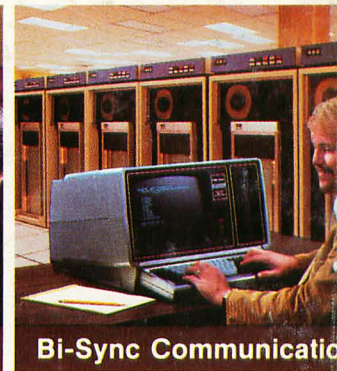
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